

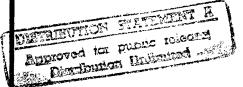
# PROGRAMMING DOCUMENTS

# ENERGY ENGINEERING ANALYSIS PROGRAM

LIMITED ENERGY STUDY

# FORT HUNTER LIGGETT, CALIFORNIA 1993

# **VOLUME IV**



19971016 195

PREPARED FOR

DEPARTMENT OF THE ARMY SACRAMENTO DISTRICT, CORPS OF ENGINEERS SACRAMENTO, CALIFORNIA

PREPARED BY

KELLER & GANNON ENGINEERS • ARCHITECTS 1453 MISSION STREET, SAN FRANCISCO, CA 94013

CONTRACT NO. DACA 05-C-92-0155

# DEPARTMENT OF THE ARMY

CONSTRUCTION ENGINEERING RESEARCH LABORATORIES, CORPS OF ENGINEERS P.O. BOX 9005

CHAMPAIGN, ILLINOIS 61826-9005

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Marie Wakeffeld, Librarian Engineering

# EEAP, Limited Energy Study Fort Hunter Liggett, California

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Army	FY 1995 MILITARY CON	FY 1995 MILITARY CONSTRUCTION PROJECT DATA				
3. INSTALLATION AND	LOCATION	4. PROJECT TITLE				
Fort Hunte	r Liggett, California	ECIP Facility Energy Improvements				
5. PROGRAM ELEMENT 6. CATEGORY CODE		7. PROJECT NUMBER	8. PROJECT COST (\$000)			
	80000		900.6			

2. DATE

### 9. COST ESTIMATES

7, 600, 201, 41-20			Unit	Cost
Item	U/M	Quantity	Cost	(\$000)
Primary Facility	ļ			717.79
Insulate ceilings and roofs	LS	_	_	(18.9)
Install duty cycling controls	LS	_	_	(26.2)
Replace heating system pipe insulation	LS	_		(2.1)
Install programmable thermostats	LS	_	_	(60.7)
Replace inefficient chillers	LS	_	_	(363.8)
Install automatic-draft dampers on space heating boilers	LS	_	_	(11.9)
Retrofit to variable air volume	LS	_	_	(111.2)
Replace inefficient boilers	LS	_	_	(25.5)
Insulate domestic hot water piping	LS	_	_	(0.6)
Insulate hot water storage tanks	LS		_	(4.1)
Install metering faucets and flow restrictors	LS	_	_	(1.2)
Recover heat from dishwasher hot water	LS	_	-	(5.3)
Install automatic draft dampers on DHW heaters	LS	_	_	(1.6)
Replace incandescent lighting with fluorescent	LS	-	_	(34.2)
Improve power factor	LS	_	-	(50.4)
Supporting Facilities				0
Estimated Contract Cost				717.7
Contingency (10%)				71.8
Subtotal				789.5
Supervision, Inspect and Overhead (5.5%)				43.4
Unescalated CWE				832.9
Escalation to FY 1995				67.7
Total Request				900.6

# 10. DESCRIPTION OF PROPOSED CONSTRUCTION

Perform the following energy conservation and cost saving retrofits:

- a. Install batt insulation in ceilings of 9 bldgs (Energy Conservation Opportunity [ECO] A4).
- b. Install duty cycling controls (programmable controllers) in 9 buildings (ECO B1).
- c. Insulate hot water heating and cooling water piping in 12 buildings (ECO B4).
- d. Install 24-hour programmable thermostats in 28 buildings (ECO B6/B7).
- e. Replace chillers with more efficient systems in 10 buildings (ECO B8).
- f. Install automatic-draft dampers on space heating equipment in 20 buildings (ECO B10).
- g. Convert multizone air-handling system to variable air volume in 5 barracks bldgs (ECO B15).
- h. Replace boilers with high-efficiency units in 7 buildings (ECO B21).
- i. Insulate domestic hot water piping in 6 buildings (ECO C2).
- j. Insulate 16 domestic hot water storage tanks in 13 buildings (ECO C3).
- k. Install self-metering lavatory faucets in 3 buildings; and install lavatory and shower flow restrictors in 2 buildings (ECO C5).
- 1. Install dishwasher heat recovery unit in Building 206 (ECO C8).
- m. Install automatic-draft dampers on domestic hot water heaters in 3 buildings (ECO C9).
- n. Replace incandescent lighting fixtures with fluorescent fixtures in 9 buildings (ECO D4).
- o. Install automatic power factor correction equipment at utility metering point. Install power factor correction capacitors on 10 HP and larger motors in 6 buildings (ECO D8).

# **DD FORM 1391**

1. COMPONENT

PROJECT: Implement energy conservation retrofits in 44 buildings. (Current mission)

<u>REQUIREMENT</u>: This project will contribute toward achieving Department of Defense facility energy goals of a 20-percent reduction in energy use per gross square feet by FY2000 versus FY1985 baseline levels.

This project will save \$124,184 annually, resulting in a 5.9-year simple payback and a savings to investment ratio of 2.25. The annual energy savings is 2,188 MBTU of electricity, 3,277 MBTU of fuel oil and 4,242 MBTU of propane. All buildings and retrofit actions will be in active use throughout the amortization period.

<u>CURRENT SITUATION</u>: Unnecessary energy is currently being consumed for space heating and cooling systems, lighting systems, and generation of domestic hot water in facilities.

<u>IMPACT IF NOT PROVIDED</u>: If this project is not accomplished, an annual energy and operations and maintenance expense of \$124,184 that could be avoided will be incurred.

<u>ADDITIONAL</u>: This project has been coordinated with the installation physical security plan, and no security improvements are required. This project incorporates recommendations of an Energy Engineering Analysis Program Limited Energy Study performed under Contract No. DACA05-92-C-0155.

Estimated Construction Start: July 1995 Index: 2049
Estimated Midpoint of Construction: September 1995 Index: 2062
Estimated Construction Completion: November 1995 Index: 2075

LOCATION: Fort Hunter Liggett, California

PROJECT TITLE: ECIP Facility Energy Improvements

# **Detailed Justification**

- 1. GENERAL: The project is a significant part of Fort Hunter Liggett's effort to achieve a 20-percent reduction in energy consumption by FY2000 versus FY1985 baseline levels.
- 2. ACCOMMODATIONS NOW IN USE: Not applicable.
- 3. ANALYSIS OF DEFICIENCY: Present system designs within the facilities proposed for retrofits account for a 14-percent loss of the total energy supplied to Fort Hunter Liggett. This translates into an additional annual cost of \$124,184.
- 4. CONSIDERATION OF ALTERNATIVES: The retrofits included in this project represent all of the economically justified actions potential energy conservation opportunities (ECO's) evaluated in the Limited Basewide Energy Study that comply with ECIP criteria.
- 5. CRITERIA FOR PROPOSED CONSTRUCTION: Design and construction will be in accordance with criteria established in DOD 4270.1-M and TM810-5.
- 6. PROGRAM FOR RELATED FURNISHINGS AND EQUIPMENT: Not applicable.
- 7. DISPOSAL OF PRESENT ASSETS: Not applicable.
- 8. SURVIVAL MEASURES: Not applicable.
- 9. SUMMARY OF ENVIRONMENTAL CONSEQUENCES: Atmospheric emissions will be reduced because less fuel will be burned as a result of implementation of this project.
- 10. EVALUATION OF FLOOD HAZARDS AND ENCROACHMENT ON WETLANDS: Not applicable.
- 11. ECONOMIC JUSTIFICATION: In accordance with Energy Conservation Investment Program (ECIP) Guidance dated November 1992, an economic analysis has been prepared. Life-cycle cost analysis results are summarized as follows:

•	Estimated Construction Cost (including SIOH) \$832,900
•	Annual Energy Savings 9,707 MBTU
•	Total First Year Dollar Savings
•	Discounted Energy Savings\$1,526,854
•	Discounted Nonenergy Savings \$366,821
•	Total Net Discounted Savings
	Savings-to-Investment Ratio

Date: June 1993

LOCATION: Fort Hunter Liggett, California

PROJECT TITLE: ECIP Facility Energy Improvements

Refer to "Detailed Calculations" for backup data.

- 12. UTILITY AND TELECOMMUNICATIONS SUPPORT: Not applicable.
- 13. PROTECTION OF HISTORIC PLACES AND ARCHEOLOGICAL SITES: Review procedures have been implemented for this project in accordance with 36 CFR 800. The review has established that there will be no effect.
- 14. PROJECT DEVELOPMENT BROCHURE: A Project Development Brochure (PDB-1) dated July 1993 has been prepared.
- 15. ENERGY REQUIREMENTS: Not applicable.
- 16. PROVISION FOR THE HANDICAPPED: Not applicable.
- 17. REAL PROPERTY MAINTENANCE ACTIVITY ANALYSIS: Not applicable.
- 18. COMMERCIAL ACTIVITIES: This project involves replacement or modification of existing systems for energy conservation. Under these conditions, the provisions of AR 5-XX do not apply, and a "new start or expansion" is not required.

Date: June 1993

LOCATION: Fort Hunter Liggett, California PROJECT TITLE: ECIP Facility Energy Improvements

**DETAILED CALCULATIONS** 

Date: June 1993

# Life Cycle Cost Analysis Summary Energy Conservation Investment Program (ECIP)

TOTAL PROJECT

	Fort Hunter Ligg Facility Energy Im			Region No. 4			Project No. Fiscal Year FY95	
Discrete Por Analysis Da	me: Total Project e 1993			Economic Life:		YEARS YEARS	Preparer: KELLER & GANNON	
1. Investme	nt Costs	<b>i</b>						
A. Construc					\$789,542	-		
B. SIOH					\$43,425	_		
C. Design C	ost				\$47,373	_		
D. Total Cos					\$880,339	_		
		Existing Equipme	ent				\$0	
		npany Rebate					(\$38,033)	
G. Total Inv	estment	(1D-1E-1F)						\$842,306
2. Energy S	avings (	+)/Cost(-)·						
		273-X Used for Di	scount Factors:	Oc	tober 1992	-		
Energy	N	Cost	Saving		Annual \$		Discount	Discounted
Source	Yrs	\$/MTBU/(1)	MBTU/YR(2)		Savings(3)		Factor(4)	Savings(5)
A. Elec.	20 Yr	\$21.84	82.1		\$1,792		14.53	_ \$26,036
	15 Yr	\$21.84	1,200.5		\$26,217		11.70	\$306,735
	15 Yr	\$18.23	905.7		\$16,510		11.70	\$193,168
B. Dist	20 Yr	\$4.98	0.0		\$0 ·		17.63	<b>\$</b> 0
	15 Yr	\$4.98	3,276.8		\$16,318		13.78	\$224,864
C. Propane	20 Yr	\$7.87	211.7		\$1,666		18.59	\$30,979
	15 Yr	\$7.87	4,030.0		\$31,716		14.16	\$449,092
D. Demand	20 Yr	\$108.60	2.3	kW	\$247		14.53	\$3,593
	15 Yr	\$108.60	230.1	kW	\$24,990		11.70	\$292,383
E. Other				•				_
F. Total			9,706.7	•	\$119,456	=		\$1,526,854
3. Non Ener	gy Savi	ngs (+) or Cost (-	):			-		
					<b>#0.400</b>	00	Vanalit	
A. Annual Recurring (+/-)				\$6,480	-	Year Life		
_			(\$1,752)	15	Year Life			
(1) Discount Factor (Table A)					-		13.59	_ 20 Year Life
							11.12	_ 15 Year Life
(2) Discounted Savings/Cost (3A x 3A1)							20 Year Life:	\$88,063

15 Year Life:

(\$19,486)

Life Cycle Cost Analysis Summary Energy Conservation Investment Program (ECIP)

**TOTAL PROJECT** 

# B. Non Recurring Savings (+) or Cost (-)

ltem	Savings(+)	Savings(+) Year of Discou		Discounted Sa	V-
	Cost(-)(1)	Occur. (2)	Factor(3)	ings(+)Cost(-)	(4)
a.	\$107,993	3	0.89	\$96,114	
b.	\$221,264	5	0.82	\$181,437	
c.	\$30,885	10	0.67	\$20,693	
d. Total	\$360,142			\$298,243	
C Total Non Energ	\$366,821				
4. Simple Payback	5.9	Years			
5. Total Net Discou	\$1,893,675				
6. Savings to Inves	2.25				
7. Adjusted Interna	9.78%				

# SUMMARY OF DD1391 ENERGY SAVING PROJECT ELEMENTS

ECO	Energy Sa	vings (Mi	llion BTU/	Year)		Annual Er	ergy Cost	Savings (	\$/Year)	
No.	Elec Use	Elec kW	Fuel Oil	Propane	Total	Elec Use	Elec Dem	Fuel Oil	Propane	Total
A4	35.4	0.0	0.0	211.7	247.1	\$774	\$0	\$0	\$1,666	\$2,441
B1	0.0	43.5	0.0	0.0	0.0	\$0	\$4,729	\$0	\$0	\$4,729
B4	0.1	0.0	60.6	32.2	92. <b>9</b>	\$1	\$0	\$302	\$253	\$556
B6/B7	686.9	0.0	2,460.0	3,223.3	6,370.2	\$15,001	\$0	\$12,251	\$25,367	\$52,619
B8	353.7	164.1	0.0	0.0	353.7	\$7,724	\$17,821	\$0	\$0	\$25,545
B10	0.0	0.0	282.8	174.3	457.1	\$0	\$0	\$1,408	\$1,372	\$2,780
B15	863.6	0.0	0.0	0.0	863.6	\$15,743	\$0	\$0	\$0	\$15,743
B21	0.0	0.0	0.0	506.1	506.1	\$0	\$0	\$0	\$3,983	\$3,983
C2	0.0	0.0	35.1	14.9	50.0	\$0	\$0	\$175	\$117	\$292
СЗ	9.2	0.0	48.3	46.1	103.6	\$168	\$0	\$240	\$363	\$771
C5	32.9	0.0	0.0	2.1	35.0	\$600	\$0	\$0	\$17	\$617
C8	0.0	0.0	339.0	0.0	339.0	\$0	\$0	\$1,688	\$0	\$1,688
C9	0.0	0.0	51.0	31.0	82.0	\$0	\$0	\$254	\$244	\$498
D4	159.8	22.5	0.0	0.0	159.8	\$3,491	\$2,439	\$0	\$0	\$5,930
D8	46.6	2.3	0.0	0.0	46.6	\$1,018	\$247	\$0	\$0	\$1,265
Total	2,188	232	3,277	4,242	9,707	44,519	25,237	16,318	33,382	119,456

# Descriptions of ECO's

A4	Insulate Ceilings and/or Roofs
B1	Install Duty Cycling Controls
B4	Replace Heating System Pipe Insulation
B6/B7	Install Time Clocks & Programmable Thermostats
B8	Replace Inefficient Chillers
B10	Install Automatic Flue Dampers on Heating System Boilers
B15	Convert Multizone HVAC Systems to Variable Air Volume
B21	Replace Inefficient Boilers
C2	Replace Pipe Insulation on Domestic Hot Water Systems
C3	Insulate Hot Water Storage Tanks
C5	Reduce Domestic Hot Water Flow at Shower Heads and Faucets
C8	Dishwasher Heat Recovery
C9	Install Automatic Flue Dampers on DHW Systems
D4	Replace Incandescent Lighting with Fluorescent
D8	Improve Power Factor

# SUMMARY OF DD1391 ENERGY SAVING PROJECT ELEMENTS

ECO	Life Cycle	Energy Co	st Savings			avings	Other	
No.	Elec Use	Elec Dem	Fuel Oil	Propane	Total	Annual \$/Yr	LCC\$	LCC Savings
A4	\$11,248	\$0	\$0	\$30,979	\$42,226	\$0	\$0	\$0
B1	\$0	\$55,334	\$0	\$0	\$55,334	(\$536)	(\$5,960)	\$0
B4	\$13	\$0	\$4,157	\$3,583	\$7,754	(\$38)	(\$420)	\$0
B6/B7	\$175,512	\$0	\$168,816	\$359,202	\$703,533	(\$1,689)	(\$18,781)	\$0
B8	\$90,371	\$208,508	\$0	\$0	\$298,880	\$0	\$0	\$298,243
B10	\$0	\$0	\$19,408	\$19,423	\$38,830	\$0	\$0	\$0
B15	\$184,188	\$0	\$0	\$0	\$184,188	(\$1,000)	(\$11,120)	\$0
B21	\$0	\$0	\$0	\$56,397	\$56,397	\$0	\$0	\$0
C2	\$0	\$0	\$2,409	\$1,660	\$4,069	\$0	\$0	\$0
СЗ	\$1,962	\$0	\$3,311	\$5,134	\$10,407	\$0	\$0	\$0
C5	\$7,017	\$0	\$0	\$239	\$7,256	\$0	\$0	\$0
C8	\$0	\$0	\$23,263	\$0	\$23,263	(\$160)	(\$1,779)	\$0
C9	\$0	\$0	\$3,500	\$3,455	\$6,954	\$0	\$0	\$0
D4	\$40,839	\$28,542	\$0	\$0	\$69,381	\$1,671	\$18,578	\$0
D8	\$14,788	\$3,593	\$0	\$0	\$18,381	\$6,480	\$88,063	\$0
Total	\$525,939	\$295,976	\$224,864	\$480,071	\$1,526,854	\$4,728	\$68,581	\$298,243

# Descriptions of ECO's

Insulate Ceilings and/or Roofs
Install Duty Cycling Controls
Replace Heating System Pipe Insulation
Install Time Clocks & Programmable Thermostats
Replace Inefficient Chillers
Install Automatic Flue Dampers on Heating System Boilers
Convert Multizone HVAC Systems to Variable Air Volume
Replace Inefficient Boilers
Replace Pipe Insulation on Domestic Hot Water Systems
Insulate Hot Water Storage Tanks
Reduce Domestic Hot Water Flow at Shower Heads and Faucets
Dishwasher Heat Recovery
Install Automatic Flue Dampers on DHW Systems
Replace Incandescent Lighting with Fluorescent
Improve Power Factor

# SUMMARY OF DD1391 ENERGY SAVING PROJECT ELEMENTS

ECO	Investment Co	sts			Economic	Evalua	tion
No.	Construction	Total	PG&E Rebate	Investment	Payback	SIR	AIRR
A4	\$20,777	\$23,166	\$0	\$23,166	9.5	1.82	7.17%
B1	\$28,795	\$32,106	(\$200)	\$31,906	7.6	1.55	7.03%
B4	\$2,359	\$2,630	\$0	\$2,630	5.1	2.79	11.36%
B6/B7	\$66,786	\$74,467	(\$13,500)	\$60,967	1.2	11.23	22.20%
В8	\$400,158	\$446,176	(\$19,688)	\$426,488	8.6	1.40	6.36%
B10	\$13,059	\$14,561	\$0	\$14,561	5.2	2.67	11.03%
B15	\$122,292	\$136,355	\$0	\$136,355	9.2	1.27	5.67%
B21	\$28,061	\$31,288	\$0	\$31,288	7.9	1.80	8.17%
C2	<b>\$65</b> 5	\$730	\$0	\$730	2.5	5.57	16.62%
СЗ	\$4,578	\$5,105	\$0	\$5,105	6.6	2.04	9.06%
C5	\$1,326	\$1,478	\$0	\$1,478	2.4	4.91	15.64%
C8	\$5,839	\$6,510	\$0	\$6,510	4.3	3.30	12.62%
C9	\$1,712	\$1,909	\$0	\$1,909	3.8	3.64	13.36%
D4	\$37,630	\$41,957	(\$4,645)	\$37,312	4.9	2.36	10.12%
D8	\$55,515	\$61,899	\$0	\$61,899	8.0	1.72	6.86%
Total	\$789,542	\$880,339	(\$38,033)	\$842,306	5.9	2.25	-

# Descriptions of ECO's

A4	Insulate Ceilings and/or Roofs
B1	Install Duty Cycling Controls
B4	Replace Heating System Pipe Insulation
B6/B7	Install Time Clocks & Programmable Thermostats
B8	Replace Inefficient Chillers
B10	Install Automatic Flue Dampers on Heating System Boilers
B15	Convert Multizone HVAC Systems to Variable Air Volume
B21	Replace Inefficient Boilers
C2	Replace Pipe Insulation on Domestic Hot Water Systems
C3	Insulate Hot Water Storage Tanks
C5	Reduce Domestic Hot Water Flow at Shower Heads and Faucets
C8	Dishwasher Heat Recovery
C9	Install Automatic Flue Dampers on DHW Systems
D4	Replace Incandescent Lighting with Fluorescent
D8	Improve Power Factor

FACILITY AND RETROFIT SUMMARY

No.   Poet Office. Main   Code   (SF)   A4   B1   B4   B47   B1   B1   B1   B21   C2   C3   C5   C5   C5   C5   C5   C5   C5	-ac		Category	Area	!			ENERG	100 X	VSER	VATIC	NOP	ORTI	V V	EME	FB			ſ
Exchange, Main Retail 73073 1,000 Exchange, Main Retail 74059 9,038 Theater with Dressing Rm's 74046 22.21 Hackender Service Station 74024 9,600 Fire Station 74024 9,600 Fire Station 74034 9,600 Gifferes Quarters Military 72410 2,550 Officers Quarters Military 72410 4,050 Outdoor Swirmming Pool 75280	Š	Installation Name	Code	(SF)	A 4	B-1	$\overline{}$	B-6/7	8-8	B-10	B-15	B-21	0.2	0-3	5.5	G	g	7	å
Exchange, Main Retail 74053  Theater with Dressing Rm's 74076  Hacienda 74046  Exchange Service Station 74034  Bowling Center 74011  Officers Quarters Military 72410  General Purp Warehouse 61065  Cold Storage Warehouse 74021  Sup Svc Admin Bldg R&D 61065  Cold Storage Warehouse 74021  Admin General Purpose 61065  Cold Storage Warehouse 74021  Admin General Purpose 61065  Cold Storage Warehouse 74021  Admin General Purpose 72210  Admin General Purpose 61065  Outdoor Swimming Pool 75030  Gymnasium 74024  74024	S 79	Post Office, Main	73073	1.000	•		ŀ			١.	1		-11-	#-	╙	3			
Theater with Dressing Rm's 74076  Hacienda Fire Station 74034  Bowling Center 74011  Officers Quarters Military 72410  General Purp Warehouse 61065  Cold Storage Warehouse 61060  General Inst Bldg R&D 61060  General Inst Barracks W/O Dining 61060  General Inst Barracks R&D 61060  General Inst Barracks R&D 61060  General Inst Barracks R	P 80	Exchange, Main Retail	74053	9,093	•	•	•	•			•			•		•	•	. (	
Hacienda  Exchange Service Station  Fire Station  Bowling Center  Officers Quarters Military  Admin General Purpose  Cold Storage Warehouse  Cold Storage Warehous	P 81	Theater with Dressing Rm's		6,719	•		, .	, '	•		,	,	•	•		•			
Exchange Service Station 74052  Fire Station 74034  Bowling Center 74011  Officers Quarters Military 72410  General Purp Warehouse 61065  Cold Storage Warehouse 74021  Sup Svc Admin Bldg R&D 61063  Post Chapel 72011  Admin General Purpose 61060  General Inst Bldg R&D 61060  General Inst Bldg 72111  Admin General Purpose 61060  General Inst Bldg 72111  Admin General Purpose 61060  General Inst Bldg 72010  Admin General Purpose 61060  Odudoor Swimming Pool 75030  Gymnasium 74028	P 101		74046	22,211	•	•	•	•	•	•		•	-	•		. 1	•	)	
Fire Station   74034     Bowling Center   74011     Officers Quarters Military   72410     Officers Quarters Military   72410     FE Facility - Shop/Office   21920     Vehicle Storage   44262     Vehicle Storage   44262     Admin General Purpose   61050     Admin General Purpose   61050     Officers Quarters Military   72410     Officers Quarters Military   74021     Sup Svc Admin Bldg   73017   74021     Admin Bldg R&D   61060   72111     Enl Barracks w/o Dining Fac   72210     Enlisted Pers Dining Fac   72210     Enlisted Pers Dining Fac   72210     Enlisted Pers Dining Fac   74062     Enlisted Pers Dining Fac   74062     Hith/Drift Clinic w/ Beds   75030     Gymnasium   74028   3	P 116		74052	1,788	•	•	•	•	, .	, .		, ,	•	) '			•	•	
Bowling Center Officers Quarters Military Officers Quarters Military Gymnasium FE Facility - Shop/Office Vehicle Storage Admin General Purpose Flec Maint. Shop Officers Quarters Military Admin General Purpose Officers Quarters Military Admin General Purpose Officers Quarters Military Officers Guarters Military Office	T 120	Fire Station	74034	9,600	•	,		•		•	•	-		•	, ,	, .	,	•	
Officers Quarters Military Officers Quarters Military Gymnasium FE Facility - Shop/Office Admin General Purpose Officers Quarters Military Officers Q	T 121	Bowling Center	74011	5,580	•	_	•	•	•	, .		-		) '		•			,
Gymnasium  FE Facility FE Facility FE Facility - Shop/Office Vehicle Storage Admin General Purpose Officers Quarters Military Cold Storage Warehouse Cold	T 127	_	72410	2,250	•	•	•	, ,	•	•		-			_	)			
Gymnasium   FE Facility   Shop/Office   21920   Vehicle Storage   A4262   Admin General Purpose   61050   Admin General Purpose   61050   Officers Quarters Military   72410   Officers Quarters Military   74021   Officers Quarters Military   74021   Officers Quarters   73017   Officers Quarters   73017   Officers Quarters   72210   Officers Quarters   72210   Officers Quarters   74062   Outdoor Swimming Pool   75030   Outdoor Swimming Pool   74028   3	P 128		72410	20,196	,	•	•	•	•	•	•	•		)	_		•		
FE Facility - Shop/Office 21920 Vehicle Storage 44262 Admin General Purpose 61050 Elec Maint. Shop Officers Quarters Military Cold Storage Warehouse 61050 Cold Storage Warehouse 44220 Cold Storage Warehouse 61065 Cold Storage Marehouse 61065 Cold Storage Warehouse 61065 Cold Storage Wareh	S 144		74034	7,172		•	,		, ,	, .							<b>-</b>		
FE Facility - Shop/Office Vehicle Storage Admin General Purpose G1050 G1050 G1050 G1050 G1050 G1050 Admin General Purpose Admin General Purpose Officers Quarters Military General Purp Warehouse Cold Storage Admin General Purpose Cold Storage Admin General Purpose Cold Storage Warehouse Cold Storage Wareh	S 146		21920	4,042	•		•	•	•	•				•	•			,	
Admin General Purpose Elec Maint. Shop Officers Quarters Military Admin General Purpose Admin General Purpose Officers Quarters Military General Purp Warehouse Cold Storage Male Cold Storage Cold Storage Warehouse Cold S	T 156		21920	2,250	•		•	, .		•	•				. ,			•	
Admin General Purpose Elec Maint. Shop Officers Quarters Military Admin General Purpose 61050 Admin General Purpose 61050 Officers Quarters Military Officers Quarters Military 72410 Officers Quarters Military General Purp Warehouse 43210 Cold Storage Warehouse 43210 Technical Library Commissary Commissary Sup Svc Admin Bldg R&D 61065 3 Admin Bldg R&D 61060 7 74021 Sup Svc Admin Bldg R&D 61060 7 74021 Sup Svc Admin Bldg R&D 61060 7 74021 Sup Svc Admin Bldg R&D 61060 7 72210 116 Enl Barracks w/o Dining Fac Enlisted Pers Dining Fac Enlisted Pers Dining Fac Enlisted Pers Dining Fac Enlisted Pers Dining Fac General Inst Bldg R&D 61050 Hlth/Drtt Clinic w/ Beds 72030 Gymnasium 74034 8	T 158		44262	1,859	,	•	•	•			•	-			, ,			 )	,
Elec Maint. Shop Officers Quarters Military Admin General Purpose Officers Quarters Military General Purp Warehouse Cold Storage Warehouse Tachnical Library Commissary Sup Svc Admin Bldg Fost Chapel Admin Bldg R&D General Inst Bldg Admin General Purpose Enlisted Pers Dining Fac Enl Barracks w/o Dining Enl Barracks w/o Dining AAFES Snack Bar AAFES Snack Bar Hith/Drit Clinic w/ Beds Outdoor Swimming Pool Gymnasium 74028 3	T 161	Admin General Purpose	61050	2,250	•	•		•	_			•			. ,	•			
Officers Quarters Military Admin General Purpose Admin General Purpose Admin General Purpose Officers Quarters Military General Purp Warehouse Cold Storage Warehouse Commissary Sup Svc Admin Bldg Fost Chapel Admin Bldg R&D General Inst Bldg Admin General Purpose Enlisted Pers Dining Fac Enl Barracks w/o Dining Enl Barracks w/o Dining AAFES Snack Bar Coutdoor Swimming Pool Cout	T 162	Elec Maint. Shop	21710	2,250	•		•	•		,				•		, ,			
Admin General Purpose Admin General Purpose Officers Quarters Military Officers Quarters Military Officers Quarters Military Officers Quarters Military General Purp Warehouse Cold Storage Warehouse Cold Warehouse Cold Warehouse Cold Storage Warehouse Cold Warehouse	T 183	Officers Quarters Military	72410	2,250	•	•	•	•	•		•		-			, ,			
Admin General Purpose Officers Quarters Military Officers Quarters Military Officers Quarters Military General Purp Warehouse Cold Storage Warehouse Commissary Sup Svc Admin Bldg Fost Chapel Admin Bldg R&D General Inst Bldg Admin General Purpose Enlisted Pers Dining Fac Enl Barracks w/o Dining Enl Barracks w/o Dining AAFES Snack Bar AAFES Snack Bar Hith/Dntt Clinic w/ Beds Coutdoor Swimming Pool	_ 164	Admin General Purpose	61050	2,250	•	•	•	•	-	_	•		_						
Officers Quarters Military Officers Quarters Military General Purp Warehouse Cold Storage Warehouse Cold Development Cntr Commissary C	T 165	Admin General Purpose	61050	2,250	•	,	-	•		•				_				 ,	
Officers Guarters Military General Purp Warehouse Cold Storage Warehouse Cold Storage Warehouse Technical Library Child Development Cntr Commissary Sup Svc Admin Bldg Post Chapel Admin Bldg R&D General Inst Bldg Admin General Purpose Enlisted Pers Dining Fac Enl Barracks w/o Dining AAFES Snack Bar AAFES Snack Bar Catholic W/ Beds Cat	T 166	Officers Quarters Military	72410	2,250	•	•	•	•		_		,				. ,			
General Purp Warehouse Cold Storage Warehouse Technical Library Child Development Cntr Commissary Sup Svc Admin Bldg Post Chapel Admin Bldg R&D General Inst Bldg Admin General Purpose Enlisted Pers Dining Fac Enl Barracks w/o Dining AAFES Snack Bar Capta 171120 72210 72111 AAFES Snack Bar Capta 27210 72111 AAFES Snack Bar Capta 27211	T 167	Officers Quarters Military	72410	2,250	•			•	,		,	,	•		_				
Cold Storage Warehouse 43210 Technical Library 61065 Child Development Cntr 74047 Commissary 74021 Sup Svc Admin Bldg 61023 Post Chapel 73017 Admin Bldg R&D 61060 General Inst Bldg 171120 Admin General Purpose 61050 Enlisted Pers Dining Fac 72210 Enl Barracks w/o Dining 72111 Enl Barracks w/o Dining 72111 Enl Barracks w/o Dining 74062 Hlth/Dntt Clinic w/ Beds 75030 Gymnasium 74028		General Purp Warehouse	44220	6,560		•	•			•									
Technical Library         61065           Child Development Cntr         74047           Commissary         74021           Sup Svc Admin Bldg         61023           Post Chapel         73017           Admin Bldg R&D         61060           General Inst Bldg         171120           Admin General Purpose         61050           Enlisted Pers Dining Fac         72210           Enl Barracks w/o Dining         72111           Enl Barracks Bar         74062           Hith/Dntt Clinic w/ Beds         55040           Outdoor Swimming Pool         74034           Gymnasium         74034           Physical Fitness Center         74028		Cold Storage Warehouse	43210	800	,	•	_	•		-	•								,
Child Development Cntr         74047           Commissary         74021           Sup Svc Admin Bldg         611023           Post Chapel         73017           Admin Bldg R&D         171120           General Inst Bldg         171120           Admin General Purpose         61050           Enlisted Pers Dining Fac         72210           Enl Barracks w/o Dining         72111           Enl Barracks w/o Dining         72111           AAFES Snack Bar         74062           Hith/Dntt Clinic w/ Beds         55040           Outdoor Swimming Pool         75030           Gymnasium         74034           Physical Fitness Center         74028		Technical Library	61065	3,599	•		•	•		-	-	•	•						
Commissary         74021           Sup Svc Admin Bldg         61023           Post Chapel         73017           Admin Bldg R&D         61060           General Inst Bldg         171120           Admin General Purpose         61050           Enlisted Pers Dining Fac         72210           Enlisted Pers Dining Fac         72111           Enl Barracks w/o Dining         72111           AAFES Snack Bar         74062           Hith/Dntt Clinic w/ Beds         55040           Outdoor Swimming Pool         74034           Gymnasium         74034           Physical Fitness Center         74028		Child Development Cntr	74047	3,599		•	•	•		_		•							1
Sup Svc Admin Bldg 61023 Post Chapel Admin Bldg R&D General Inst Bldg 171120 Admin General Purpose 61050 Enlisted Pers Dining Fac 72210 Enl Barracks w/o Dining 72111 Enl Barracks w/o Dining 72111 AAFES Snack Bar 74062 Hith/Dntt Clinic w/ Beds 55040 Outdoor Swimming Pool 75030 Gymnasium 74028	_	Commissary	74021	3,000	•	_	_,	•			•			_	_		. ,		
Admin Bldg R&D 61060 General Inst Bldg 171120 Admin General Purpose 61050 Enlisted Pers Dining Fac 72210 Enl Barracks w/o Dining 72111 Enl Barracks w/o Dining 72111 AAFES Snack Bar 74062 Hith/Dntt Clinic w/ Beds 55040 Outdoor Swimming Pool 75030 Gymnasium 74034		Sup Svc Admin Bldg	61023	1,920	•	•		•				•		_			1 1	•	•
Admin Bldg R&D General Inst Bldg Admin General Purpose Enlisted Pers Dining Fac Enl Barracks w/o Dining AAFES Snack Bar Hlth/Dntt Clinic w/ Beds Outdoor Swimming Pool Gymnasium 74034 Physical Fitness Center 771120 72210 72210 72211 72210 72210 72210 72210 72211 74052		Post Chapel	73017	2,720		-	•	_				•	•	_	_				
General Inst Bldg Admin General Purpose Enlisted Pers Dining Fac Enl Barracks w/o Dining Enl Barracks w/o Dining AAFES Snack Bar Hith/Dntt Clinic w/ Beds Outdoor Swimming Pool Gymnasium 74028 Physical Fitness Center 74028		Admin Bldg R&D	61060	7,728	•	_		-		•				_	_			_	
Admin General Purpose 61050 Enlisted Pers Dining Fac 72210 Enl Barracks w/o Dining 72111 Enl Barracks w/o Dining 72111 AAFES Snack Bar 74062 Hith/Dntt Clinic w/ Beds 55040 Outdoor Swimming Pool 75030 Gymnasium 74034	_	General Inst Bidg	171120	1,090		•	_	-					_		_				,
Enlisted Pers Dining Fac Ful Barracks w/o Dining Ful Barracks w/o Dining AAFES Snack Bar Hith/Drit Clinic w/ Beds Outdoor Swimming Pool Gymnasium 74034 Physical Fitness Center 77210 72210 72111 74062	_	Admin General Purpose	61050	40,981		•	-	•	_		•								. (
Enl Barracks w/o Dining 72111 Enl Barracks w/o Dining 72111 AAFES Snack Bar 74062 Hith/Dntl Clinic w/ Beds 55040 Outdoor Swimming Pool 75030 Gymnasium 74034 Physical Fitness Center 74028		Enlisted Pers Dining Fac	72210	16,768	,	•	•	, ,						_	_	_		_	 D
AAFES Snack Bar AAFES Snack Bar Hith/Dntt Clinic w/ Beds Outdoor Swimming Pool Gymnasium 74034 Physical Fitness Center		Enl Barracks w/o Dining	72111	35,820	•	•	•	•	_		_					_			. (
AAFES Snack Bar Hith/Dntt Clinic w/ Beds 55040 Outdoor Swimming Pool 75030 Gymnasium 74034 Physical Fitness Center 74028		Enl Barracks w/o Dining	72111	40,981		•	•	•		_	_		) '					_	_
Hith/Dntl Clinic w/ Beds 55040 Outdoor Swimming Pool 75030 Gymnasium 74034 Physical Fitness Center 74028		AAFES Snack Bar	74062	3,320	•		•	•											_
Outdoor Swimming Pool 75030 Gymnasium 74034 Physical Fitness Center 74028		Hth/Dntl Clinic w/ Beds	55040	10,973	•	_		, •		_							_	_	
Gymnasium 74034 Physical Fitness Center 74028		Outdoor Swimming Pool	75030	•		_					_							_	
Physical Fitness Center 74028		Symnasium	74034	8,907	•	_		•											
		Physical Fitness Center	74028	3,212		_	_	•	_	_			_	_					

ECO recommended for this building

# FACILITY AND RETROFIT SUMMARY

Fac		Category	Area				ENERGY CONSERVATION OPPORTUNITY NUMBER	37 CC	NSE	<b>VATI</b>	O NO	PORT P	E	NON.	BER			
Š	Installation Name	Code	(SF)	4	<del>-</del>	B-4	B-6/7	B-8	B-10	B-15	B-21	ပ္ပ	င်	C-5	ဗီ	ပ်	4	8
н	Enle	72111	40,915		•	•	•	•	•	•		•		•	•		•	•
P 230	Enl Barracks w/o Dinfing	72111	40,981		•	•	•	•	•	•	•	•	•		•		•	•
\$ 235	S 235 Admin General Purpose	61050	3,000	•	•		•		•	•	•	•	•	•	•	•	,	•
S 236	S 236 Admin General Purpose	61050	3,000	,		•	•	٠	•	•	•	•	•	,		•	,	•
\$ 237	Admin General Purpose	61050	3,000	,	•	ı	•		٠	•	•	•	•	•	•	• (	• (	•
\$ 238	S 238 Sig Photo Lab	14130	14,548	,	•	•	,	•	•	•	•	•	•	•	•	•	•	•
P 240	Admin General Purpose	61050	3,000	•	•	,	•		•		•	•	•	1	•	•		•
\$ 241	S 241 GM Facility	31220	10,000	•		•	•		•	•	•	•	•		•	•		
\$ 243	S 243 Admin General Purpose	61050	3,000			•	٠		•	٠	•	•	•			•	,	
\$ 244	Admin General Purpose	61050	3,000		•		•	•	•	•	,	,	٠	٠	•	•	•	
S 246	S 246 Admin General Purpose	61050	3,000	•		,	•	,	1	•	•	•	٠	•	•	•		•
\$ 247	Admin General Purpose	61050	3,000	,	•		٠	•	•	•		•	•	•	•	,	•	
P 252	P 252 Vehicle Maint Shop DS	21420	12,299	,		•	,	•	•	•		٠	•	•	!	•	•	•
P 256	Vehicle Maint Shop ORG	21410	5,294		•	•	•	,	•				•	1	•		•	•
P 259	Vehicle Maint Shop ORG	21410	13,667	•	•	•	•		•	•	•	•	•	•	,	,	•	
\$ 283	S 283 FE Maintenance Shop	44220	4,000	•	•	,	•	•	•	•	•	•	٠	•	•		•	•
S 286	Admin General Purpose	61050	3,000	•	•		·		•	•		٠	•	•	•		•	•
P 287	P 287 Recreation Building	74069	5,584	•			,		,	•	1	•	•		•	•	•	•
\$ 288	General Purpose Warehous	44220	3,000	•	•		٠	•	•	•	•	•	•	•	•	•	•	•
S 290	Electron Equip Facility	31740	14,856	•		•	•	•	•		•	•	•				•	,
S 291	S 291 Cont Humid Warehouse	44230	7,400	,		•	•	•	•	•	•	٠	•	•	٠	•	•	•
P 295	Enl Barracks w/o Dining	72111	46,593		•	•	•	•	•	•	•	•	•	•	•	•	•	4
P 301	301 ADP Building	61031	10,800				•	•	,	•	•	•	٠	•		•	•	•
P 642	P 642 Detached Latrine/Shower	72324	992			•	١	•	•	•	•		•	•	•		•	•
S 220	Control Tower - Range SPT	17123	891	·	·	•	٠	•		-		٠		·		٠		٠
											ĺ		l					

# ECO Number / Description

B-21 Replace Inefficient Boilers	G-2 Replace Pipe Insulation on Domestic Hot Water Systems	C-3 Insulate Hot Water Storage Tanks	C-5 Reduce Domestic Hot Water Flow at Shower Heads and Faucets	C-8 Dishwasher Heat Recovery	ilers C-9 Install Automatic Flue Dampers on DHW Systems	ne D-4 Replace Incandescent Lighting with Fluorescent
Insulate Ceilings and/or Roofs	Install Duty Cycling Controls	Replace Heating System Pipe Insulation	B-6/7 Install Time Clocks & Programmable Thermostats	Replace Inefficient Chillers	B-10 install Automatic Flue Dampers on Heating System Bollers	B-15 Convert Multizone HVAC Systems to Variable Air Volume
Ξ		B-4	_	B-8	_	

Improve Power Factor

0.0 0.4 0.8

ECO recommended for this building

# Life Cycle Cost Analysis Summary Energy Conservation Investment Program (ECIP)

Region No. 4

Fort Hunter Liggett, California

Location:

ECO A4

Project No.

		ergy improvements				Fiscal Year FY95
Discrete Portion N	lame: ECO A4	Insulate Ceilings an	d/or Roofs			
Analysis Date: Ju	ne 1993		Economic Life:	20	YEARS	Preparer: KELLER & GANNON
1. Investment Cos	ts	· · · · · · · · · · · · · · · · · · ·				
A. Construction C	osts		\$20,777	_		
B. SIOH			\$1,143	_		
C. Design Cost			\$1,247			
D. Total Cost (1A-	+1B+1C)		\$23,166	•		
E. Salvage Value					\$0	
F. Public Utility Co	mpany Rebate	)			\$0	
G. Total Investmen	nt (1D-1E-1F)					\$23,166
2. Energy Savings				_		
Date of NISTIR 85	-3273-X Used f	or Discount Factors:	October 1992			
Energy	Cost	Saving	Annual \$		Discount	Discounted
Source	\$/MTBU/(1)	MBTU/YR(2)	Savings(3)		Factor(4)	Savings(5)
A. Elec.	\$21.84	35.4	\$774		14.53	\$11,248
B. Dist	\$4.98	0.0	\$0		17.63	\$0
C. Propane	\$7.87	211.7	\$1,666		18.59	\$30,979
D. Demand	\$108.60	0.0 kW	\$0		14.53	\$0
E. Other				=		
F. Total			\$2,441			\$42,226
0 M = 5 0						
3. Non Energy Sa	vings (+) or Co	ost (-):	<del></del>	-		
A Annual Decurring	ng (+/)		\$0			
A. Annual Recurring (1) Discount Factor  (2) Annual Recurring  (3) Annual Recurring  (4) Discount Factor  (5) Annual Recurring				•	13.59	
(2) Discounted Sa	-	v 3A1\			10.55	<b>\$</b> 0
(2) Discouriled Sa	virigs/Cost (SA	X SAT)				ΨΟ
B. Non Recurring	Savings (+) or	Cost (-)				
D. Norrheculting	outings (1) or	000.()				
Item	Savings(+)	Year of	Discount		Discounted Sa	IV-
1.0.11	Cost(-)(1)	Occur. (2)	Factor(3)		ings(+)Cost(-)	
		( <u>-</u> )	,		g=(.,/===.(,/	( )
a.						
b.						
c.			-			
d. Total				=		
a. retai						
C Total Non Energ	y Discounted	Savings (3A2+3Bd4	)		\$0	
		<b>~</b> `	•		-	
4. Simple Payback	c 1G/(2F3+3A+	⊦(3Bd1/Economic Li	fe)):		9.5	Years
5. Total Net Disco		•			\$42,226	
6. Savings to Inve	_	•			1.82	
7. Adjusted Interna					7.17%	

# **ECO A4: INSULATE CEILINGS AND/OR ROOFS**

Buildings without ceiling or roof insulation are considered. Buildings considered are listed in the attached calculations.

Energy savings are based on a TRANE-TRACE computer simulation run on a 1,000 SF "Model" structure for Fort Hunter Liggett. (See attached) Energy savings are determined on a roof/ceiling square foot basis as follows:

### **Cooling Load and Electric Savings**

Baseline =	68,596	BTUH, Load
ECO A-4 Insulation =	57,922	BTUH, Load
Savings =	10,674	BTUH, Load

Assume an EER = 10.0, thus, Electric Energy Savings for buildings with Air Conditioning are =

1.067 Watts / SF

Results are extended on a roof/ceiling SF basis, using the building cooling degree-hour calculation, design inside and outside temperatures as follows:

[Roof/Ceiling SF] x [1.067 W/SF] / [1,000 W/kW] x [Bldg CDHr/Yr] / [Design Delta T] = kWH/Yr Saved

### **Heating Load and Energy Savings**

Baseline =	34,440	BTUH, Load
ECO A-4 Insulation =	28,447	BTUH, Load
Savings =	5,993	BTUH, Load

Load Savings are, thus = 5.99 BTUH / SF

Energy Savings are based on the building heating system efficiency. Fuel oil or propane savings are determined by dividing the load savings by the system efficiency and multiplying by the building full load hours per year (determined by dividing the building heating degree hours by the design inside-outside temperature difference).

### **Construction Cost**

Construction costs are estimated based on "Means Construction Cost Estimating Guide 1993" for fiberglass type batt insulation with moisture barrier.

# BASELINE, BEFORE ECO A4 IMPLEMENTED

Trane Air Conditioning Economics

By: Trane Customer Direct Service Network

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System	1	Peak	PTAC		TERMINAL									
****	****	******			*****	*****	****	**** CLG	SPACE	PEAK ****** /18 +	***** HEATI	NG COIL PE	1K ***	****
Peaked at	Time ==	: <b>&gt;</b>	Mo/Hr: 7						Hr: 7,			Mo/Hr: 13/	•	
Outside A	ir ==>	OAD	B/WB/HR: 9	6/ 70/ 70.0				C/A	DB: 9	1 *		OADB: 27		
								_			0 Dk	. 0.41 0.	_1	
		Space	Ret. Air	Ret. Air	Net			•	ace	Percnt *	Space Peak			ercnt
	S	ens.+Lat.	Sensible	Latent	Total			Sensi		Of Tot *	Space Sens			of Tot
Envelope	Loads	(Btuh)	(Btuh)	(Btuh)	(Btuh)		(%) *	(Bt	uh)	(%) *	(Btuh)	•		(%)
Skylite	Solr	0	0		(	-	.00 *		0	0.00 *	0		0	0.0
Skylite	Cond	0	0		(		.00 *		0	0.00 *	0		0	0.0
Roof Co	and	0	14,919		14,919		.75 *		0	0.00 *	0	.,-		22.9
Glass S	olar	15,120	0		15,120	_			.940	35.17 *	( 204		0	0.0
Glass C	ond	2,421	0		2,42		.53 *		002	4.16 *	-6,291	-		18.2
Wall Co	and	23,987	6,143		30 <b>,13</b> 0		92 *	24,	108	50 <b>.05</b> *	-16,474	-		58.8
Partiti	on	0			(		.00 *		0	0.00 *	(		0	0.0
Exposed	floor	0				-	.00 *		0	0.00 *	(		0	0.0
Infiltr	ation	0					.00 *	. –	0	0.00 *	22.74		0	0.0
Sub Tot		41,528	21 <b>,062</b>		62,59	0 91.	.24 *	43,	,050	89.37 *	-22,765	-34,4	40	100.0
Internal		•					*			*				
Lights		1,707	0		1,70	<b>7</b> 2.	.49 *		,707	3.54 *	(		0	0.0
People		4,300			4,30	0 6.	.27 *	1,	,800	3.74 *	(		0	0.0
Misc		. 0	0	0	(	0 0.	.00 *		0	0.00 *	(	)	0	0.0
Sub Tot	-= la	6,007	0	0	6,00	7 8.	.76 *	3,	,506	7.28 *	(	)	0	0.0
Ceiling L		1,961	-1,961			0 0.	.00 *	1,	,614	3 <b>.35</b> *	-1,109	,	0	0.0
Outside /		0	0	0		0 0.	.00 *		0	0.00 *	(	)	0	0.0
Sup. Fan		•	_			0 0.	.00 *			0.00 *			0	0.0
Ret. Fan			0		1	0 0.	.00 *			0.00 *			0	0.0
Duct Heat			0		1	0 0.	.00 *			0.00 *			0	0.0
OV/UNDR S		0	_		1	0 0.	.00 *		0	0.00 *	(	)	0	0.0
Exhaust i		•	0	0		0 0	.00 *			0.00 *			0	0.0
Terminal			0			0 0	.00 *			0.00 *			0	0.0
erminat	Бураза						*			*				
Grand To	tal==>	49,496	19,100	0	68,59	6 100	.00 *	48	, 170	100.00 *	-23,87	3 -34,4	40	100 <b>.0</b>
			c <b>oo</b>	LING COIL SE							T-4-			
	Total	Capacity	Sens Cap.			ing DB			_	WB/HR	Gross Tota	1,000	(sf)	(4)
	(Tons)	(Mbh)	(Mbh)	(cfm)	-	eg F		Deg F	_	Grains		0		
lain Clg	5.7	6 <b>8.6</b>	66.1	3,219		64.5	66.9		57.5	67.2	Part	0		
Aux Clg	0.0	0.0	0 <b>.0</b>	0	0.0	0.0	0.0		0.0	0.0	ExFlr			0
pt Vent	0.0	0 <b>.0</b>	0 <b>.0</b>	0	0.0	0.0	0.0	0.0	0.0	0.0		1,000		
otals	5.7	6 <b>8.6</b>									Wall	1,400	14	0 1
	HEAT1	NG COIL SEL	ECTION		A	IRFLOW	S (cfm	)	6	ENGINEERING	CHECKS	TEMPERAT	TURES	(F)
	Capaci			Lvg	Туре	Cool	ing	Heating	Cle	2 X OA	0.0	Туре	Clg	Htg
	(Mbh	•		Deg f	Vent		0	0	Cle	cfm/Sqft	3 <b>.22</b>	SADB	61.2	74.
lain Htg	-50		219 60.3		Infil		0	0	Cla	cfm/Ton	56 <b>3.16</b>	Plenum	81.2	59.
lux Htg		.0	0 0.0		Supply	3,	219	3,219	Cl	sqft/Ton	174.94	Return	81.1	60.
			219 60.7		Mincfm		0	0	Cle	g Btuh/Saft	68 <b>.60</b>	Ret/OA	81.1	60
reheat		.0	0 0.0		Return	3,	219	3,219	No.	. People	10	Runarnd	75.0	68
Reheat		.0	0 0.0		Exhaust	• •	0	. 0		g % OA	0.0	Fn MtrTD	0.0	0.
Humidif			0 0.0		Rm Exh		0	0		g Cfm/SqFt	3.22	Fn BldTD	0.0	0.
Opt Vent		.0	0 0.0	. 0.0	Auxil		0	0		g Btuh/SqFt		Fn Frict	0.0	0.
Total	-50				AUAIL		-	•						

# AFTER ECO A4 IMPLEMENTED

Trane Air Conditioning Economics
By: Trane Customer Direct Service Network

V 600 PAGE 5

		*****	YOU THE COT!	DEAK ****	****	*****	****	**** CLG	SPACE	PEAK ****	***** HEA	TING COIL PE	EAK *1	*****
				7/18			*	Mo/	Hr: 7	/18 *		Mo/Hr: 13,	1	
Peaked at		-> ^Ar		71/ 68/ 70.0			*	OA!	DB: 9	1 *		OADB: 2	7	
Outside A	/1L ==>	UNA.	, <b>u</b> , uu,	.,			*			*				
		Space	Ret. Air	Ret. Air	Net	Percn	t *	Sp	ace	Percnt *	Space Pe	ak Coil Po	ak	Percnt
		ens.+Lat.	Sensible	Latent	Total	Of To	t *	Se <b>ns</b> i	ble	Of Tot *	Space Se	ns Tot S	ens	Of Tot
Envelope	-	(Btuh)	(Btuh)	(Btuh)	(Btuh)	(%	<b>)</b> *	(Bt	uh)	(%) *	(Btu	h) (Bti	Ų)	(%)
Skylite		0	0		0	0.0	0 *		0	0.00 *		0	0	0.00
Skylite		0	0		C	0.0	0 *		0	0.00 *		0	0	0.00
Roof Co		0	2,272		2,272	3.9	2 *		0	0.00 *		0 -1,	468	5 <b>.16</b>
Glass S		16,940	0		16,940	29.2	5 *	18,	550	39 <b>.05</b> *		0	0	0.00
Glass C		2,002	0		2,002	3.4	6 *	1,	523	3.21 *	-6,2	91 -6,	291	22.11
Wall Co		24,108	6 <b>,594</b>		30 <b>,70</b> 2	53.0	1 *	23,	224	48 <b>.89</b> *	-16,4	74 -20,	688	72 <b>.72</b>
Partiti		0	•		C	0.0	0 *		0	0.00 *		0	0	0.00
Exposed		0			C	0.0	0 *		0	0.00 *		0	0	0.00
Infiltr	_	0			C	0.0	0 *		0	0.00 *		0	0	0.00
Sub Tot		43,050	8, <b>865</b>		51,915	89.6	3 *	43,	297	91.14 *	-22,7	65 -28,	447	100.00
Internal		,	•				*			*				
Lights	••••	1,707	0		1,707	2.9	5 *	1,	707	3.59 *		0	0	0.00
People		4,300			4,300	7.4	2 *	1,	800	3.79 *		0	0	0.00
Misc		0	0	0	(	0.0	0 *		0	0.00 *		0	0	0.00
Sub Tot	ta(==>	6,007	0	0	6,007	7 10.3	7 *	3,	506	7.38 *	i	0	0	0.00
Ceiling t		812	-812		(	0.0	ю *		704	1.48 *		15	0	0.00
Outside /		0	0	0	(	0.0	ю *		0	0.00 *	!	0	0	0.00
Sup. Fan					(	0.0	<b>6</b> *			0.00 *	!		0	0.00
Ret. fan			0		(	0.0	<b>*</b>			0.00 *	•		0	0.00
Duct Heat	t Pkup		0		(	0.0	<b>*</b>			0.00 *			0	0.00
OV/UNDR S	Sizing	0			(	0.0	<b>*</b>		0	0 <b>.00 *</b>	'	0	0	0.00
Exhaust i	Heat		0	0	(	0.0	* 00			0.00 *	1		0	0.00
Terminal	Bypass		0	0	(	0.0	0 *			0.00			0	0.00
										100.00			,,,	100.00
Grand To	tal==>	49 <b>,868</b>	8,054	0	57 <b>,92</b> 2	2 100.0	<b>*</b>	47,	,507	100.00	-23,2	280 -28,	441	100.00
			coo	LING COIL SE	LECTION							AREAS		
	Total	Capacity	Sens Cap.	Coil Airfl		ing DB/l			-	B/WB/HR	Gross Tot		<b>s</b> (st	F) (%)
	(Tons)	(Mbh)	(Mbh)	(cfm)	Deg F De	eg F G		Deg F	_	Grains	Floor	1,000		
Main Clg	4.8	57 <b>.9</b>	55.4	3,170	77.5	63 <b>.3</b>	66.9	61.2	57.3	66.0	Part	0		
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0 <b>.0</b>	0.0	0.0	ExFlr	0		
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0 <b>.0</b>	0.0	0.0	Roof	1,000		0 (
Totals	4.8	57 <b>.9</b>									Wall	1,400	7	140 10
	HEATI	NG COIL SEL	ECTION	•••••	A	IRFLOWS	(cfm)	,		ENGINEERING	CHECKS	TEMPERA	TURES	(F)
	Capaci			Lvg	Type	Cooli	ng	Heating	Cl	% CA	0.0	Type	Clg	Htg
	(Hbh		ma) Deg F	Deg F	Vent		0	0	CL	g Cfm/Sqft	3.17	SAD8	61.2	
Main Htg	-37		170 63.9	74.8	Infil		0	0		Cfm/Ton	65 <b>6.65</b>	Plenum	77.6	
Aux Htg		.0	0 0.0	0.0	Supply	3,1	70	3,170		g Sqft/Ton		Return	77.5	
Preheat			170 64.2	61.2	Mincfm		0	0		g Btuh/Sqf1		Ret/OA	77.5	
Reheat		.0	0 0.0	0.0	Return	3,1	70	3,170		. People	10	Runarnd	75.0	
Humidif		.0	0 0.0	0.0	Exhaust		0	0		g % OA	0.0	Fn MtrTD	0.0	
Opt Vent		1.0	0 0.0	0.0	Rm Exh		0	0	Ht	g Cfm/SqFt		Fn BldTD	0.0	
	-37				Auxil		0	0	U de	g Btuh/SqF	t -37.22	Fn Frict	0.6	0 0.

ECO A4 INSULATE CEILINGS / ROOFS

Bldg	Area	Heating	Cooling	Heating   Cooling   Heating   Energy		Use W/Previous EC   Energy Use W/ECO-A4	ious EC	Energy Us	se W/ECO	-A4		Energy Savings	avings	Energy (	<b>Energy Cost Savings</b>	gs	
	(SF)	Degree	Degree	Efficienc	Electric	Propane	Fuel Oil	Electric	Electric Propane Fuel Oil	Fuel Oil	Electric	Propane Fuel Oil	Fuel Oil	Electric	Propane	Fuel Oil	
		Hours	Hours		Kwh/Yr	MBTU/Y MBTU/Y	MBTU/Y	Kwh/Yr	KWH/Yr MBTU/Y MBTU/Y	MBTU/Y	Kwh/Yr	MBTU/Y	MBTU/Y	\$/YR	\$/YR	\$/YR	Total
127	2,250	85,120	21,833	64.0%	2,783	193.1		1,036	154.1	•	1,747	39.0	0.0	\$130	\$307	0\$	\$437
161	2,250	60,531	15,420	72.0%	3,872	71		2,638	46.3	•	1,234	24.7	0.0	\$92	\$194	0\$	\$286
162	2,250	60,531	15,420	72.0%	3,872	71		2,638	46.3		1,234	24.7	0.0	\$92	\$194	0\$	\$286
163	2,250	60,531	15,420	72.0%	3,872	71		2,638	46.3		1,234	24.7	0.0	\$92	\$194	0\$	\$286
164	2,250	60,531	15,420	72.0%	3,872	71		2,638	46.3		1,234	24.7	0.0	\$92	\$194	0\$	\$286
165	2,250	60,531	15,420	72.0%	3,872	71		2,638	46.3	•	1,234	24.7	0.0	\$92	\$194	0\$	\$286
166	2,250	60,531	15,420	72.0%	3,872	71		2,638	46.3		1,234	24.7	0.0	\$92	\$194	0\$	\$286
167	2,250	60,531	15,420	72.0%	3,872	71		2,638	46.3	•	1,234	24.7	0.0	\$92	\$194	0\$	\$286
TOTLAS			-								10,385	212	0	\$774	\$1,666	0\$	
				-						l							

# **ECO A4 COST SAVINGS**

00	842 226	\$23 166	\$20 777					TOTALS
1.7	\$4,946	\$2,896	\$2,597	\$2,361	\$2,338	\$1,798	\$1,665	167
1.7	\$4,946	\$2,896	\$2,597	\$2,361	\$2,338	\$1,798	\$1,665	166
1.7	\$4,946	\$2,896	\$2,597	\$2,361	\$2,338	\$1,798	\$1,665	165
1.7	\$4,946	\$2,896	\$2,597	\$2,361	\$2,338	\$1,798	\$1,665	<b>5</b>
1.7	\$4,946	\$2,896	\$2,597	\$2,361	\$2,338	\$1,798	\$1,665	183
1.7	\$4,946	\$2,896	\$2,597	\$2,361	\$2,338	\$1,798	\$1,665	162
1.7	\$4,946	\$2,896	\$2,597	\$2,361	\$2,338	\$1,798	\$1,665	161
2.6	\$7,603	\$2,896	\$2,597	\$2,361	\$2,338	\$1,798	\$1,665	127
	Savings \$	₩	B×1.10	OHP x 1.01	GC x 1.30	CC x 1.08	Cost (CC) \$	Number
SIR	LCC Energy	Investment	Bond Contingency	Bond	OH & P	Gen Cond	Building   Construction Cost	Building

Construction Cost....Bare cost (see cost estimates)

General Conditions......8% of total plus Construction Cost

OH & P.......Contractors overhead and profit 30% of Gen Cond plus Gen Cond

Bond......1% of OH&P plus OH&P

Contingency.......Estimators contingency 10% of Bond plus Bond

Investment.......Total Construction Cost (Contingency) plus 5.5% SIOH & 6% for Design

Electricity = 14.53

Propane = 18.59

Fuel Oil = 17.63

SIR.....LCC Savings/Investment

CONSTRUCTION COST ES	TIMAT			Date Prepared June 1993	3	Sheet Of	
Project				Project No.	Basis for	Estimate	
EEAP Limited Energy Study							
Location					Code A	(no design compe	eted)
Fort Hunter-Liggett, California				***************************************	1		
Engineer-Architect							
Keller & Gannon		Estimat	or		Checked	Ву	
ECO A-4 Insulate Ceilings/Roofs						•	
Line Item	Que No.	untity Unit	Per	Labor	Per	Material	Total
Line item	Units	Meas.	Unit	Total	Unit	Total	Cost
Building 127							
R-19 Batt Insulation	2250	SF	\$0.24	\$540	\$0.50	\$1,125	\$1,665
Subtotal Building 127							\$1,665
Building 161							
R-19 Batt Insulation	2250	SF	\$0.24	\$540	\$0.50	\$1,125	\$1,665
Subtotal Building 161					1	1 - 1	\$1,665
Building 162 through 167			<u> </u>		1		
R-19 Batt Insulation	2250	SF	\$0.24	\$540	\$0.50	\$1,125	\$1,665
Subtotal Building 162 through 167					1	1 1	\$1,665
Cubickar Building 102 timough 10.	_	-	<del> </del>			1	Ψ1,000
Building 252			<u> </u>			l	
R-19 Batt Insulation	12300	SF	\$0.24	\$2,952	\$0.50	\$6,150	\$9,102
Subtotal Building 252	12000	-	<del> </del>	1 42,002	10.00	1 10,100	\$9,102
Odbiola Ballaning Lea			<u> </u>				40,.02
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# Life Cycle Cost Analysis Summary Energy Conservation Investment Program (ECIP)

ECO B-1

	ECIP Facility Er	ggett, California nergy Improvements			Project No. Fiscal Year	FY95
	ate: June 1993	O B1 Install Duty (	Economic Life: 15	YEARS	Preparer: KELL	ER & GANNON
1. Investme A. Construe B. SIOH	ction Costs		\$28,795 \$1,584			
E. Salvage F. Public U	Cost ost (1A+1B+1C Value of Existin tility Company f vestment (1D-1E	ng Equipment Rebate	\$1,728 \$32,106	\$200	- - \$31,906	
	Savings (+)/Cos	st(-): Used for Discount F	actors: October	1992		
Energy Source	Cost \$/MTBU/(1)	Saving MBTU/YR(2)	Annual \$ Savings(3)	Discount Factor(4)	Discounted Savings(5)	
A. Elec. B. Dist C. Propan D. Other E. Demand F. Total	\$21.84 \$4.98 \$7.87 @ \$108/kW-Yr	43.5 kW	\$0 \$0 \$0 \$0 \$4,729	11.70 13.78 14.16	\$0 \$0 \$0 \$55,334	<u> </u>
3. Non Ene	ergy Savings (+)	) or Cost (-):				
(1) Discour	Recurring (+/-) nt Factor (Table nted Savings/Co		(\$536)	11.12	(\$5,960)	
B. Non Red	curring Savings	(+) or Cost (-)				
ltem	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Saings(+)Cost(-		
a. b. c. d. Total			-			
C Total No	n Energy Disco	unted Savings (3A2	+3Bd4)	(\$5,960)		
<ul><li>5. Total Ne</li><li>6. Savings</li></ul>	t Discounted Sa to Investment R	3+3A+(3Bd1/Econ avings (2F5+3C): atio (SIR) 5/1G: f Return (AIRR):	omic Life)):	7.6 \$49,374 1.55 7.07%	Years	

# **ECO B1: INSTALL DUTY CYCLING CONTROLS**

Duty cycling controls are installed to reduce the electrical demand charges. HVAC system equipment with fairly constant loading are selected for control. Duty cycling controls are assumed to turn off each device for a period of 10 minutes during each hour. Thus, energy demand charge cost savings are based on 1/6 th of the connected load. Savings are calculated as follows:

Motor Size: HP

Motor Efficiency: Eff%

Motor kW: HP x 0.746 kW/HP / Eff%

New kW (with Duty Cycling): Motor kW x 5 / 6

Electrical Demand Cost Savings per Year: \$108.60 / kW x (Motor kW - New kW)

Economic Life (N): 15 Years

Life Cycle Electrical Demand Cost Savings:

(Cost Savings per Year) x (UPW for Electricity for N = 15 Years)

Added O&M Cost: Assumes 2 MH per year at \$33.50/Hr per controller

LCC Added O&M Costs: Added O&M Cost per Year x Non-Energy UPW for N = 15 Years

Construction Costs: Based on "Means Construction Cost Estimating Guide 1993"

Investment: Construction Cost plus 5.5% SIOH and 6% Design allowance less PG&E Rebate of \$25 per Timer Device. Note, controller and point wiring costs are estimated separately. One controller (with rebate) is expensed per building and one point per controlled drive is expensed).

ECO B-1 (Duty Cycling) Cost Savings

Building	Item to be	o Z	9	Mtr	Κ	Total	New	Demand	Demand	Demand	O&M Saved	O&M Saved O&M Saved	Invest	Simple	SIR
	Controlled	Ea.		Eff		κM	κW	kW Saved	\$/Yr	\$LCC	\$/⊀r	\$ CCC	↔	Payback	
Summary	Summary of Building Analysis Factors	S.													
101	Elec Res Heaters (1)	-	•	100%	58.0	58.0	48.3	9.67	\$1,050	\$12,283	(\$67)	(\$745)	\$4,080	4.15	2.83
205	Supply Fan Motor	-	52	87%	21.4	21.4	17.9	3.6	\$388	\$4,540					
	Return Fan Motor	_	10	85%	8.8	8.8	7.3	1.5	\$159	\$1,859					
	Hot Water Pump	-	_	83%	6.0	6.0	0.7	0.1	\$16	\$190					
	Total					31.1		5.2	\$563	\$6,589	(\$67)	(\$745)	\$4,080	8.22	1.43
206	Supply Fan Motor	2	10	85%	8.8	17.6	14.6	2.9	\$318	\$3,717					
	Return Fan Motor	ď	က	83%	2.7	5.4	4.5	6.0	\$38	\$1,142					
	Hot Water Pump	-	_	83%	6.0	6.0	0.7	0.1	\$16	\$190					•
	Total					23.8		4.0	\$432	\$5,050	(\$67)	(\$745)	\$4,080	11.19	1.06
207	Supply Fan Motor	-	25	87%	21.4	21.4	17.9	3.6	\$388	\$4,540					
	Return Fan Motor	-	9	85%	8.8	89.09	7.3	7.	\$159	\$1,859					
	Hot Water Pump	-	-	83%	6.0	6.0	0.7	0.1	\$16	\$190					•
	Total					31.1		5.2	\$563	\$6,589	(\$67)	(\$745)	\$4,080	8.22	1.43
208	Supply Fan Motor	-	52	%28	21.4	21.4	17.9	3.6	\$388	\$4,540					
	Return Fan Motor	<del>-</del>	0	85%	8.8	8.8	7.3	7.5	\$159	\$1,859					
	Hot Water Pump	_	_	83%	6.0	0.0	0.7	0.1	\$16	\$190					
	Total				31.1	31.1	25.9	5.5	\$563	\$6,589	(\$67)	(\$745)	\$4,080	8.22	1.43
229	Supply Fan Motor	-	52	%28	21.4	21.4	17.9	3.6	\$388	\$4,540					
	Return Fan Motor	-	9	82%	8.8	8.8	7.3	7.	\$129	\$1,859					
	Hot Water Pump	_	-	83%	6.0	6.0	0.7	0.1	\$16	\$190					
	Total				31.1	31.1	25.9	5.5	\$563	\$6,589	(\$67)	(\$745)	\$4,080	8.22	1.43
230	Supply Fan Motor	-	52	%28	21.4	21.4	17.9	3.6	\$388	\$4,540					
	Return Fan Motor	_	9	82%	8.8	8.8	7.3	1.5	\$159	\$1,859					
	Hot Water Pump	-	-	83%	6.0	6.0	0.7	0.1	\$16	\$190					
	Total				31.1	31.1	25.9	5.2	\$563	\$6,589	(\$67)	(\$745)	\$4,080	8.22	1.43
238	Fan Coil Unit SA Fan	-	20	87%	17.1	17.1	14.3	2.86	\$310	\$3,632					
	Fan Coil Unit RA Fan	-	7.5	83%	6.74	6.7	5.6	1.12	\$122	\$1,428				•	
	Total				23.89	23.9	19.91	3.98	\$432	\$5,059	(\$67)	(\$745)	\$3,349	9.17	1.29
Total								43.55	\$4,729	\$55,334	(9838)	(096'5\$)	\$31,906	7.61	1.55
NOTES:	1. Hacienda has 90 kW connected load of 3 kW electric resistance space heaters. Assume that 60% are left on during the day, and	onnec	ted loa	d of 3 k	W electr	ic resista	ance sp	ace heater	s. Assume	that 60% a	re left on duri	ng the day, a	nd		

Hacienda has 90 kW connected load of 3 kW electric resistance space heaters. Assume that 60% are left on during the day, and assume a 90% room occupancy rate. (The Hacienda is usually filled year-round.) Thus, load is 90 x .60 x .90 = 58 kW. Hacienda electric resistance heaters assumed controlled by 3 panel, each as "one" contact control point.

Date Prepared Sheet Of CONSTRUCTION COST ESTIMATE June 1993 Project No. **Basis for Estimate** Project **EEAP Limited Energy Study** Code A (no design competed) Location Fort Hunter-Liggett, California Engineer-Architect Keller & Gannon Estimator Checked By Drawing No. **RJB** BIH Quantity Labor Material Per Line Item No. Unit Total Units Meas. Unit Total Unit Total Cost Programmable Controller 1 EA \$350 \$350 \$750 \$750 \$1,100 General Conditions @ 8% \$88 Subtotal \$1,188 Contractor OH & Profit @ 30% \$356 Subtotal \$1,544 Bond @ 1% \$15 Subtotal \$1,560 Estimating Contingency @ 10% \$156 **Total Probable Construction Cost** \$1,716 Digital Output Control w/Wiring 1 EA \$100 \$100 \$320 \$320 \$420 General Conditions @ 8% \$34 Subtotal \$454 Contractor OH & Profit @ 30% \$136 Subtotal \$590 Bond @ 1% \$6 Subtotal \$596 Estimating Contingency @ 10% \$60 **Total Probable Construction Cost** \$655

# ECO B4

# Life Cycle Cost Analysis Summary Energy Conservation Investment Program (ECIP)

Location: Project Title:	ECIP Facility E	iggett, California nergy Improveme	nts	Region No. 4			Project No Fiscal Yea	
Discrete Portio	on Name: ECO E	3-4 Replace Heati	ng S	System Pipe Ins	ulati	on		
Analysis Date:	March 1993		I	Economic Life:	15	YEARS	Preparer:	KELLER & GANNON
1. Investment				40.050	-			
A. Constructio	n Costs		_	\$2,358	-			
B. SIOH			_	\$130	-			
C. Design Cos			=	\$142	=			
D. Total Cost (	•	· · · · · · · · · · · · · · · · · · ·		\$2,630		\$0		
	lue of Existing E y Company Reb					\$0 \$0		
-	ment (1D-1E-1F				•	Ψ0		\$2,630
2. Energy Savi	ings (+)/Cost(-)	:			_			
Date of NISTIF	85-3273-X Use	d for Discount Fac	ctors	: October 1992	2			
Energy	Cost	Saving		Annual \$		Discount	Disc	counted
Source	\$/MTBU/(1)	MBTU/YR(2)	;	Savings(3)		Factor(4)	Sav	ings(5)
A. Elec.	\$21.84	0.1		\$1.15		11.70		\$13
B. Dist	\$4.98	60.6		\$301.68		13.78	:	\$4,157
C. Propane	\$7.87	32.2		\$253.04		14.16	;	\$3,583
D. Demand	\$108.60	0.0 k	W	\$0.00		11.70		\$0
E. Other			_		_			
F. Total			-	\$555.87	-			\$7,754
3. Non Energy	Savings (+) or	Cost (-):			-			
A. Annual Rec	urring (+/-)		_	(\$38)	_			
· ·	actor (Table A)					11.12		
(2) Discounted	I Savings/Cost (	3A x 3A1)						(\$420)
B. Non Recurr	ing Savings (+)	or Cost (-)			•			
Item	Savings(+) Cost(-)(1)	Year of Occur. (2)		Discount Factor(3)		Discounted Sa ings(+)Cost(-)		
a.								
b.		. <del> </del>		-				
C.		= =====================================	-					
d. Total								
C Total Non E	nergy Discounte	ed Savings (3A2+3	3Bd4	4)		(\$420)		
	•	3A+(3Bd1/Econon	nic L	_ife)):		5.1	Yea	rs
	scounted Saving					\$7,333		
	nvestment Ratio					2.79		
7. Adjusted Int	ternal Rate of Re	eturn (AIRR):				11.36%		

# ECO B4: REPLACE HEATING SYSTEM PIPE INSULATION

efficiency; boiler efficiency for heating systems and the EER (Watts/BTUH) for cooling systems.

### **Energy Cost Savings**

Annual and life cycle energy cost savings are determined as follows:

### **Annual Energy Cost Savings:**

Electricity

kWH/Yr Saved x 0.003413 MBTU/kWH x \$21.84/MBTU = \$/Yr Saved

Propane

MBTU/Yr Saved x \$7.87/MBTU = \$/Yr Saved

Fuel Oil

MBTU/Yr Saved x \$ 4.98/MBTU = \$/Yr Saved

Life Cycle Energy Cost Savings for economic life of 15 years:

Electricity

\$/Yr Saved x (15 year UPW: 11.70) = LCC \$ Saved

Propane

 $\$  Yr Saved x (15 year UPW: 14.16) = LCC \$ Saved

Fuel Oil

\$/Yr Saved x (15 year UPW: 13.78) = LCC \$ Saved

### **Construction Cost Estimate**

Bare costs are estimated based on "Means Construction Cost Estimating Guide 1993". Results are provided on the attached cost estimating forms.

Construction cost is determined by applying the following cumulative adders:

General Conditions:

8.0%

Estimating Contingency:

10.0%

Contractor's Overhead and Profit:

30.0%

Bond:

1.0% -

Investment is determined by adding the following separate factors of the construction cost:

Supervision, Inspection and (Government) Overhead (SIOH):

5.5%

Allowance for Design Services:

6.0%

### **Operation and Maintenance Cost Savings**

Maintenance costs are expensed at 2.5% of the bare costs of installation per year. Note that as "Savings", entries are negative, or in parentheses.

Life cycle maintenance cost savings are determined by multiplying the annual maintenance cost savings by the non-energy UPW factor of 11.12 (15 year economic life).

### **Economic Analysis**

Total Life Cycle Cost (LCC) Savings: Sum of energy and O&M LCC costs savings.

Simple Payback Period: Investment divided by the sum of annual energy and O&M cost savings.

Savings to Investment Ratio (SIR): Total LCC cost savings divided by the investment.

# ECO B4: REPLACE HEATING SYSTEM PIPE INSULATION

Steam, Hot Water and Chilled Water piping needing replacement insulation is listed by building on the attached tabular summary.

Thermal losses result from uninsulated steam, hot or chilled water piping. Energy savings are achieved when such pipes are insulated.

Energy savings are determined for each pipe size and service type by using nomographs developed by the U.S. Department of Energy (DOE) from their publication: "Energy Conservation in Existing Buildings", February 1980.

Use of the nomographs results in a heat loss (gain) rate of: BTUH per LF for "Bare" pipe and for various thicknesses of insulation on piping. For the purposes of these calculations, it is assumed that 1-inch of insulation is applied.

The attached tabular calculations are performed as follows:

### Pipe Heat Loss (Gain) Calculations

Size In-Dia.:

Nominal pipe size, diameter in inches

Length LF:

Pipe length needing insulation, linear feet

Type HW/CHW:

Type of service STM (Steam), HW (Hot Water) and CHW (Chilled Water)

# Heat Loss Rate BTU/Hr-LF (from Nomographs)

Bare Pipe:

Rate of heat loss or gain in BTUH/LF for bare pipe determined from the

DOE nomograph

Insulated Pipe:

Rate of heat loss or gain in BTUH/LF for insulated pipe (1-inch

thickness) determined from the DOE nomograph

Heating Degree Hr/Yr:

Heating Degree Hours determined for the building based on meteorologic

data, the building usage schedule and inside thermostatic set points.

**Boiler Efficiency:** 

Heating system boiler efficiency determined based on measurements of combustion efficiency and a field assessment of existing conditions.

For cooling systems, an EER of 10.0 is assumed.

### **Energy Savings Calculations**

Thermal Loss/Gain:

The thermal loss/gain "Load" is determined by multiplying the difference between BTUH/LF for bare and insulated pipe by the linear feet of piping

to be insulated.

Annual Loss/Gain:

The annual load loss/gain is determined by multiplying the rate of loss (BTUH) by full load system hours per year. Full load system hours per year is determined by dividing the heating/cooling degree hours per year

by the design winter/summer temperature difference.

**Annual Energy Savings:** 

Annual energy savings is the annual load loss/gain divided by the system

ECO1 B-4 REPLACE PIPE INSULATION

ECO1 B-4 REPLACE PIPE INSULATION

Bldg	LCC En	LCC Energy Cost Savings	Savings		Construction Cost Estimate	on Cost E	stimate	O&M Savings	ivings	Economic Analysis	Analysis	
	Elec	Propane	iö	Total	Bare	Constr	Investment	Annual	ည	Total LCC	Simple	SIR
	CCC \$	\$ CC	CCC \$	\$ OOT	Cost \$	Cost \$	Total \$	\$/Yr	Total \$	Saved \$	Payback	
80	Ϋ́	\$1,311	Ν	\$1,311	\$225	\$351	\$391	(9\$)	(\$63)	\$1,249	4.50	3.19
190	NA	NA	\$263	\$263	89\$	\$106	\$118	(\$5)	(\$19)	\$244	6.79	2.07
206	Α̈́	AN	NA	AN	•	•	•		•	,	•	•
206	Ϋ́	ΑΝ	A A	AN	1	•	•	•	•	ı	•	,
206	¥	ΑΝ	AN	ΑΝ	•	•	•	•		ı	•	
206 TOTAL	¥	AN	\$1,546	\$1,546	\$269	\$420	\$468	(\$2)	(\$75)	\$1,471	4.44	3.15
207	¥	ΑN	\$587	\$587	\$140	\$218	\$243	(\$4)	(68\$)	\$548	6.23	2.25
208	¥	ΑΝ	\$587	\$587	\$140	\$218	\$243	(\$4)	(68\$)	\$548	6.23	2.25
209	Α̈́	\$297	AN	\$297	\$45	\$70	878	(\$1)	(\$13)	\$285	3.94	3.64
219	Α̈́	NA	NA	NA	•	•	•	•	•	•	•	
219	Α̈́	Α×	AN	ΑΝ	3		•	1	1	1	•	
219 TOTAL	AA	\$600	NA	009\$	06\$	\$140	\$157	(\$2)	(\$25)	\$575	3.90	3.67
229	¥	ΑΝ	\$587	\$587	\$140	\$218	\$243	(\$4)	(683)	\$548	6.23	2.25
230	AN	NA	\$587	\$587	\$140	\$218	\$243	(\$4)	(62\$)	\$548	6.23	2.25
238	NA	\$266	ΝA	\$266	\$45	\$20	878	(\$1)	(\$13)	\$254	4.43	3.24
241	A	A A	A	AN	•	•	•	•	,	1	ı	
241	ΑΝ	Ν	NA	A A	•	1		•	•	1	•	
241 TOTAL	\$13	\$606	NA	\$619	\$140	\$218	\$243	(\$4)	(\$33)	\$580	6.03	2.38
291	NA	\$203	NA	£0 <b>5</b> \$	0/\$	\$109	\$122	(\$5)	(\$19)	\$483	3.61	3.97
TOTALS	\$13	\$3,583	\$4,157	\$7,754	\$1,512	\$2,358	\$2,630	(\$38)	(\$450)	\$7,333	5.08	2.79

CONSTRUCTION COST ES	TAMIT	Έ		Date Prepared June 1993	3	Sheet of	
Project EEAP Limited Energy Study				Project No.	Basis for	Estimate	
Fort Hunter-Liggett, California					Code A	(no design compe	ted)
Engineer-Architect					1		
Keller & Gannon Drawing No.		Estimat	Or.		Checked	By	
ECO B4: Replace Pipe Insulation			RJB		Oriocked	BIH	
Lee b4. Replace Fipe modiation	Qu	antity	1.05	Labor	1	Material	
Line Item	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	Total Cost
Building 80							
1-1/2" Pipe Insulation	50	LF	\$2.50	\$125	\$2.00	\$100	\$225
Subtotal Bldg 80							\$225
Building 190							
1-1/4" Pipe Insulation	15	LF	\$2.50	\$38	\$2.00	\$30	\$68
Subtotal Bldg 190							\$68
Building 206							
1-1/2" Pipe Insulation	10	LF	\$2.50	\$25	\$2.00	\$20	\$45
3" Pipe Insulation	15	LF	\$3.50	<del></del>	\$5.00		<del></del>
4" Pipe Insulation	10	LF	\$3.60	\$36	\$6.00	\$75 \$60	\$128 \$96
Subtotal Bldg 190	10		\$3.00	\$30	\$0.00	\$60	\$269
Subjectal Blug 190		<b>-</b>			<u> </u>		φ209
Building 207							
2-1/2" Pipe Insulation	20	LF	\$3.00	\$60	\$4.00	\$80	\$140
Subtotal Bldg 207							\$140
Building 208							
2-1/2" Pipe Insulation	20	LF	\$3.00	\$60	\$4.00	\$80	\$140
Subtotal Bldg 208							\$140
Building 209							
1-1/4" Pipe Insulation	10	LF	\$2.50	\$25	\$2.00	\$20	\$45
Subtotal Bldg 209						720	\$45
Building 219			-				
3/4" Pipe Insulation	10	LF	\$2.50	\$25	\$2.00	\$20	\$45
1-1/2" Pipe Insulation		LF	\$2.50	\$25	\$2.00	\$20	\$45
Subtotal Bldg 219				7.3	750	7.0	\$90
Building 229							
2-1/2" Pipe Insulation	20	LF	\$3.00	\$60	\$4.00	\$80	¢1.40
Subtotal Bldg 229	20	<u> 1</u>	Ψ0.00	900	φ4.00	\$00	\$140 \$140

CONSTRUCTION COST ES	TIMAT	E		Date Prepared June 1993	3	Sheet of	
Project  EEAD Limited Energy Study				Project No.	Basis for	<u> </u> Estimate	
EEAP Limited Energy Study				1	Code A	(no design compe	eted)
Fort Hunter-Liggett, California						•	,
Keller & Gannon							
Drawing No.		Estimat	or		Checked	Ву	
ECO B4: Replace Pipe Insulation			RJB		1	BIH	
		antity		Labor	1	Aaterial	
Line Item	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	Total Cost
Building 230							
2-1/2" Pipe Insulation	20	LF	\$3.00	\$60	\$4.00	\$80	\$140
Subtotal Bldg 230							\$140
							W
Building 238			1				
1-1/2" Pipe Insulation	10	LF	\$2.50	\$25	\$2.00	\$20	\$45
Subtotal Bldg 238						· · · · ·	\$45
							7
Building 241							
2-1/2" Pipe Insulation	10	LF	\$3.00	\$30	\$4.00	\$40	\$70
2" Pipe Insulation		LF	\$3.00	\$30	\$4.00	\$40	\$70
Subtotal Bidg 241			70.00	750	4 1.00	4.0	\$140
Odbiotal Blog 2.11	<del>                                     </del>	<del></del>					ΨΙΤΟ
Building 291	<del></del>		-			<u> </u>	
2" Pipe Insulation	10	LF	\$3.00	\$30	\$4.00	\$40	\$70
Subtotal Bldg 291	T		1		<del>                                     </del>	<del>                                     </del>	\$70
Outroid July 20.		·					Ψ/ Ο
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# Life Cycle Cost Analysis Summary Energy Conservation Investment Program (ECIP)

ECO B6 & 7

Location: Project Title:	Fort Hunter Ligg ECIP Facility Ener		Re	egion No. 4		Project No. Fiscal Year FY95
		6 & B7 Install Time		_		
Analysis Date	: June 1993		E	conomic Life:	15 YEARS	Preparer: KELLER & GANNON
1. Investment	Coete					
A. Construction				\$66,786		
B. SIOH				\$3,673		
C. Design Co	st			\$4,007		
D. Total Cost	(1A+1B+1C)			\$74,467		
E. Salvage Va	alue of Existing Eq	juipment			\$0	_
F. Public Utili	ty Company Reba	ite			(\$13,510)	<del></del>
G. Total Inves	stment (1D-1E-1F)					\$60,957
	vings (+)/Cost(-):					
Date of NISTI	R 85-3273-X Used	for Discount Factor	rs: Octo	ber 1992		
Energy	Cost	Saving	Ar	nnual \$	Discount	Discounted
Source	\$/MTBU/(1)	MBTU/YR(2)	Sa	vings(3)	Factor(4)	Savings(5)
	,, ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,				.,	• , ,
A. Elec.	\$21.84	686.9	_	\$15,001	11.70	\$175,515
B. Dist	\$4.98	2,460.0	_	\$12,251	13.78	\$168,816
C. Propane	\$7.87	3,223.3		\$25,367	14.16	\$359,202
D. Demand	\$108.60		kW	\$0	11.70	<b>\$0</b>
E. Other				#F0 C10		A300 F00
F. Total				\$52,619		\$703,533
3. Non Energ	y Savings (+) or 0	Cost (-):				
				/ft4_600\		
A. Annual Red				(\$1,689)	11.12	
	Factor (Table A) d Savings/Cost (3	A v 2A1\			11.12	/¢10 701\
(2) Discounte	d Savings/Cost (S	AXSAI)				(\$18,781)
B. Non Recur	ring Savings (+)	or Cost (-)				
ltom	Sovings(±)	Year of	Di	scount	Discounted Sav-	
Item	Savings(+) Cost(-)(1)	Occur. (2)		ctor(3)	ings(+)Cost(-)(4)	
	0031(1)(1)	O 0001. (2)	, ,	0.01(0)	111g5(1)005t()(4)	
a.						
b.				-		•
C.						
d. Total						•
C Total Non E	Energy Discounted	d Savings (3A2+3Bo	d4)		(\$18,781)	
4. Simple Pay	/back 1G/(2F3+3 <i>F</i>	A+(3Bd1/Economic	Life)):		1.2	Years
	iscounted Saving		,,		\$684,752	
	Investment Ratio				11.23	
	nternal Rate of Ret				22.20%	

# ECO B6 & B7: INSTALL TIME CLOCKS & PROGRAMMABLE THERMOSTATS

Installation of controls for HVAC systems will reduce energy consumption by scheduling heating and cooling service for times when it is needed and control temperatures depending on building use. Time clocks and programmable thermostats are recommended for installation in buildings which are listed in the following tabular calculations.

Energy savings are achieved by providing use-appropriate temperature control. For example, shops and warehouses are not heated to the same temperatures as are offices and dwellings. Energy savings are also achieved by controlling building HVAC systems to provide heat and cooling only during the days and times of day when it is needed. Setback temperature control is also made possible, i.e., the reduction of space heating temperature setpoints when spaces are not scheduled for use. The simultaneous operation of heating and cooling systems is also prevented by installation of these controls.

Time clocks are specified whenever building occupants do not have direct access to HVAC controls. Programmable thermostats are used for buildings and zones which require occupant control of HVAC functions.

### **Energy Savings Calculations**

Energy savings calculations are a function of the building operating schedule, present controls, the building heating and cooling loads, site weather data, present and authorized space temperatures and operating schedules.

Heating and cooling loads are determined using either the TRANE-TRACE building energy use computer program or manual calculations for both the "Baseline" and proposed control conditions. Energy savings are calculated by applying building HVAC system operating parameters to calculated load savings. Calculations depend, in large part, on heating and cooling degree hours calculated for time and temperature schedules of each building.

Degree hours are calculated based on simulated bin temperature data (refer to EEAP Limited Energy Study for Fort Hunter Liggett, dated 1993). The design temperature difference during each temperature period and time-of-year are used to calculate total annual heating and cooling degree hours. Full load hours are determined and multiplied by the building block load and divided by HVAC device efficiencies to determine energy use with and without proposed controls.

Annual energy cost savings are based on energy savings calculations and energy costs:

Electricity	kWH/Yr Saved x 0.003413 MBTU/kWH x \$21.84/MBTU = \$/Yr Saved
Propane	MBTU/Yr Saved x \$ 7.87/MBTU = \$/Yr Saved
Fuel Oil	MBTU/Yr Saved x \$ 4.98/MBTU = \$/Yr Saved

Life Cycle Energy Cost Savings for economic life of 15 years:

Electricity	\$/Yr Saved x (15 year UPW: 11.70) = LCC \$ Saved
Propane	\$/Yr Saved x (15 year UPW: 14.16) = LCC \$ Saved
Fuel Oil	\$/Yr Saved x (15 year UPW: 13.78) = LCC \$ Saved

### **Construction Cost Estimate**

Bare costs are estimated based on "Means Construction Cost Estimating Guide 1993". Results are provided on the attached cost estimating forms.

### **ECO B6 & B7: INSTALL TIME CLOCKS & PROGRAMMABLE THERMOSTATS**

Construction cost is determined by applying the following cumulative adders to bare costs:

General Conditions: 8.0%
Estimating Contingency: 10.0%
Contractor's Overhead and Profit: 30.0%
Bond: 1.0%

Investment is determined by adding the following separate factors of the construction cost:

Supervision, Inspection and (Government) Overhead (SIOH): 5.5% Allowance for Design Services: 6.0%

PG&E rebates of \$40 per thermostat are subtracted to determine the final investment.

# **Operation and Maintenance Cost Savings**

Additional O&M costs are expensed to provide initial and annual follow-up training and instructions concerning the operation of the proposed control systems. The additional annual O&M cost is \$6.05 per thermostat (or time clock).

Life cycle additional O&M costs are determined by multiplying the annual additional O&M costs by the non-energy UPW factor of 11.12 (15 year economic life).

### **Economic Analysis**

Total Life Cycle Cost (LCC) Savings: Sum of energy and O&M LCC costs savings.

Simple Payback Period: Investment divided by the sum of annual energy and O&M cost savings.

Savings to Investment Ratio (SIR): Total LCC cost savings divided by the investment.

ECO B6/7 TIME CLOCKS AND PROGRAMMABLE THERMOSTATS

Fac		Existing Schedule	hedule	Heating Season		Cooling	Degree Ho	Degree Hours per Year, 7 Days/WI	7 Days/Wk			FULL LOAD HOURS/YEAR	<b>JUHS/YEAR</b>
ģ	Installation Name	Time	Time	Setpoint	ack	Setpoint	Heating	Heating	Htg Setbk	Total	Total	Heating	Cooling
		HVAC ON	HVAC	Deg F	Deg F	Deg F	N <sub>O</sub>		7 Day/Wk	Heating	Cooling	FLHr/Yr	FLHr/Yr
P 80	Exchange, Main Retail	006	1700	89	55	72	18,715	40,610	44,615	59,325	18,106	425	604
101	Open Din Cons (Haclenda)	1000	1600	02	52	72	14,616	42,688	44,615	57,304	15,420	318	514
	Club (Bar)	1600	2200	2	22	72	21,855	40,134	44,615	61,989	9,650	475	322
	Hacienda, East Rooms	1700	8	2	55	¥ Z	98,616	7,025	44,615	105,641	ž	2,144	0
	Hacienda, West Rooms												
T 121	Bowling Center	008	2200	89	22	72	42,842	33,140	44,615	67,020	21,833	911	250
P 128	Officers Quarters Military	900	2200	88	55	72	60,015	25,104	44,615	85,119	21,833	1,364	728
S 146	FE Facility	700	1600	55	40	78	10,781	3,537	5,161	11,702	6,003	281	268
T 161	Admin General Purpose	700	1600	89	55	72	33,064	33,833	44,615	60,531	15,420	756	367
T 162	Elec Maint. Shop	700	1600	88	55	72	33,064	33,833	44,615	60,531	15,420	756	367
T 163	Officers Quarters Military	700	1600	88	55	72	33,064	33,833	44,615	60,531	15,420	756	367
F 164	Admin General Purpose	700	1600	88	55	72	33,064	33,833	44,615	60,531	15,420	922	367
r 165	Admin General Purpose	200	1600	89	55	72	33,064	33,833	44,615	60,531	15,420	756	367
l 166	Officers Quarters Military	200	1600	89	55	72	33,064	33,833	44,615	60,531	15,420	994	367
167	Officers Quarters Military	700	1600	89	55	72	33,064	33,833	44,615	60,531	15,420	756	367
771 d	Technical Library	700	1600	89	. 55	72	33,064	33,833	44,615	166,531	15,420	952	367
P 178	Child Development Cntr	909	1800	72	55	72	988'95	29,446	44,615	74,412	19,953	1,022	475
S 182	Commissary	900	1700	89	55	72	18,715	40,610	44,615	55,122	18,106	268	431
S 186	Sup Svc Admin Bidg	700	1600	89	52	72	33,064	33,833	44,615	60,531	15,420	226	367
P 205 P 205A	Admin General Purpose Company HQ Building	009	2200	88	55	72	60,015	25,104	44,615	73,547	21,833	1,137	520
P 207 P 207A	Enl Barracks w/o Dining Company HQ Building	009	2200	89	. 55	72	60,015	25,104	44,615	85,119	21,833	1,364	728
P 208 P 208A		009	2200	89	35	72	60,015	25,104	44,615	85,119	21,833	1,364	728
P 209	AAFES Snack Bar	900	1600	89	55	72	41,952	29,585	44,615	71,537	15,420	953	514
P 212	Gymnasium	1000	2100	99	40	72	18,590	5,161	5,161	23,751	21,833	453	728
P 229 P 229A	Enl Barracks w/o Dining Company HQ Building	009	2200	88	55	72	60,015	25,104	44,615	85,119	21,833	1,364	728
<b>P 230</b> P 230A		900	2200	89	55	72	60,015	25,104	44,615	85,119	21,833	1,364	728
S 283	FE Maintenance Shop	200	1700	22	40	72	10,781	4,287	5,161	12,238	15,420	288	<b>29</b> E
S 290	Electron Equip Facility	200	1600	89	55	72	33,064	33,833	44,615	60,531	15,420	95/	367
\$ 291	Cont Humid Warehouse	200	1600	89	22	72	33,064	33,833	44,615	165,09	15,420	952	298
P 295	Eni Barracks w/o Dining	009	2200	89	55	72	60,015	25,104	44,615	85,119	21,833	1,364	728
301	ADP Building Office	700	1600	89	22	72	33,064	33,833	44,615	60,531	15,420	992	367
	Computer Room	0	2400	88	89	74	115,562	0	0	115,562	17,007	2,626	607
										+			

ECO B6/7 TIME CLOCKS AND PROGRAMMABLE THERMOSTATS

_	_												*				···-															
		SIR	72.489	2.712	2.122	10.426	4.845	8.054	8.054	8.054	8.054	8.054	8.054	8.054	25.203	199.929	27.965	17.518	12.163	12.163	12.163	27.803	95.318	12.163	12.163		13.170	54.151	42.067	8.007	112.407	11.233
Analysis	Simple	Payback	0.18	4.34	6.42	1.31	2.71	1.57	1.57	1.57	1.57	1.57	1.57	1.57	0.50	90:0	0.47	0.74	1.14	1.14	1.14	0.43	0.15	1.14	1.14		1.08	0.25	0.32	1.67	0.12	1.20
Life Cycle Cost Analysis	LCC,N=15	Savings	\$18,659	\$22,296	\$850	\$92,690	\$2,183	\$3,113	\$3,113	\$3,113	\$3,113	\$3,113	\$3,113	\$3,113	\$4,871	\$7,302	\$5,405	\$6,771	\$32,910	\$32,910	\$32,910	\$10,747	\$36,845	\$32,910	\$32,910		\$2,545	\$41,864	\$16,261	\$185,695	\$43,451	\$684,752
	Total	Invest	\$257	\$8,221	2387	\$8,891	\$451	\$387	\$387	\$387	\$387	\$387	\$387	\$387	\$193	\$37	\$193	\$387	\$2,706	\$2,706	\$2,706	\$387	\$387	\$2,706	\$2,706		\$183	\$773	\$387	\$23,193	\$387	\$60,957
	PG&E	Rebate	\$40	\$1,280	06\$	\$2,070	\$85	06\$	08\$	06\$	<b>8</b> 80	06\$	06\$	\$30	\$45	<b>S</b>	\$45	06\$	069\$	\$630	\$630	06\$	06\$	069\$	069\$		\$45	\$180	06\$	\$5,400	05\$	\$13,510
	Total	Cost	\$297	105,501	<b>17.3</b>	\$10,961	\$536	\$477	747	5477	\$477	\$477	\$477	\$477	\$238	\$37	\$238	\$477	966,63	9EE'E\$	\$3,336	\$477	5477	966,62	\$3,336		\$238	\$953	547	\$28,593	7. 7.	\$74,467
Cost	Constr	Cost	\$267	\$8,521	\$427	\$9,830	\$480	\$427	\$427	\$427	\$427	\$427	\$427	\$427	\$214	\$33	\$214	\$427	\$2,992	\$2,992	\$2,992	\$427	\$427	\$2,992	\$2,992		\$214	\$885	\$427	\$25,644	\$427	\$66,786
Construction	Bare	Cost	\$171	\$5,463	\$274	\$6,302	\$308	\$274	\$274	\$274	\$274	\$274	\$274	. \$274	\$137	\$21	\$137	\$274	\$1,918	\$1,918	\$1,918	\$274	\$274	\$1,918	\$1,918		\$137	\$548	\$274	\$16,440	\$274	\$42,816
Γ	သ	\$ Total	(\$7)	(\$2,159)	(\$7)	(\$3,103)	(\$67)	(\$7)	(\$7)	(\$7)	(\$7)	(\$7)	(\$7)	(\$7)	(\$67)	(\$67)	(\$67)	(\$7)	(\$944)	(\$944)	(\$944)	(\$7)	(\$7)	(\$944)	(\$944)		(\$67)	(\$270)	(\$7)	(\$8,095)	(\$7)	(\$18,781)
Non-Energy Saving	Non-Egy	\$/Yr	(\$1)	(\$194)	(\$1)	(\$279)	(\$6)	(\$1)	(\$1)	(\$1)	(\$1)	(\$1)	(\$1)	(\$1)	(\$6)	(36)	(36)	(\$1)	(\$82)	(\$82)	(\$82)	(\$1)	(\$1)	(\$8\$)	(\$82)		(9\$)	(\$24)	(\$1)	(\$728)	(\$4)	(\$1,689)
	Total	\$/Year	\$1,442	\$2,090	\$61	\$7,057	\$172	\$246	\$246	\$246	\$248	\$246	\$246	\$246	\$394	\$593	\$419	\$520	\$2,458	\$2,458	\$2,458	\$908	\$2,619	\$2,458	\$2,458		\$185	960'c\$	\$1,215	\$14,645	83,188	\$52,619
avings	Fuel Oil	\$/Year	OS:	<b>\$</b>	<b>&amp;</b>	æ	0\$	<b>0\$</b>	8	8	8	8	O\$	\$0	<b>⊗</b>	8	O\$	8	\$2,450	\$2,450	\$2,450	<b>8</b> €	<b>\$</b>	\$2,450	\$2,450		<b>&amp;</b>	<b>&amp;</b>	æ	8	8	\$12,251
nergy Cost S	Propane	\$/Year	\$728	8	7.2	\$5,375	96\$	\$97	263	297	263	283	2897	\$97	\$132	\$176	\$231	\$282	S.	OS.	O\$	\$54	\$2,526	0\$	8		\$181	\$2,403	\$832	\$9,125	\$2,502	\$25,367
ECO B6/B7 Energy Cost Savin	Electric	\$/Year	\$715	\$2,090	\$14	\$1,683	92\$	\$150	\$150	\$150	\$150	\$150	\$150	\$150	\$263	\$417	\$188	\$238	<b>8</b>	<b>8\$</b>	8\$	\$823	26\$	8\$	8		3	\$693	\$383	\$5,520	\$687	\$15,001
	Fuet Oil	Mil BTU/Yr	0.0	0:0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	492.0	492.0	492.0	0.0	0.0	492.0	492.0		0:0	0.0	0.0	0.0	0.0	2,460
'gy Savings	Propane	Mil BTU/Yr	92.5	0.0	6.0	682.9	12.2	12.3	12.3	12.3	12.3	12.3	12.3	12.3	18.7	22.4	29.4	35.8	0.0	0.0	0.0	6.9	321.0	0.0	0.0		23.0	305.4	105.7	1,159.5	317.9	3,223
ECO B6/B7 Energy Savings	Electric	kWH/Yr	9,589	28,041	186	22,574	1,022	2,006	2,006	2,006	2,006	2,006	2,006	2,006	3,526	5,588	2,522	3,197	105	105	105	11,449	1,238	105	105		25	9,292	5,142	74,049	9,212	201,252
Fac			P 80	P 101	T 121	P 128	8 146	T 161	T 162	T 163	T 164	T 165	T 166	T167	P 177	P 178	S 182	S 186	P 205 P 205A	P 207 P 207A	P 208 P 208A	P 209	P 212	P 229	P 230	P 230A	S 283	S 290	\$ 291	P 295	P 301	Totals

CONSTRUCTION COST ES	TAMIT	Έ		Date Prepared June 1993	3	SHEET	OF
Project				Project No.	Basis for	<u> </u> Estimate	
EEAP Limited Energy Study				<u> </u>	Code A	(no design serve	
Fort Hunter-Liggett, California					Code A	(no design comp	etea)
Engineer-Architect							
Keller & Gannon Drawing No.		Estimate	or		Checked	Bv	
ECO-B6/7 (T-Clock / Programmable	Tstat)	RJB			він	-,	
	Qu	antity		bor	<u>'</u>	Material	
Line Item	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	Total Cost
Building 80							
Time Clock & Wiring	1	EA	\$51	\$51	\$120	\$120	\$171
Subtotal (Bldg 80)							\$171
Building 101 Dining & Lounge Areas	and Dwe	elling L	Jnits				
Time Clock & Wiring - Din/Lng	2	EA	\$51	\$102	\$120	\$239	\$341
Time Clock & Wiring - Dwellings	30	EA	\$51	\$1,534	\$120	\$3,587	\$5,121
Subtotal (Bldg 101 Dining & Lounge /	Areas ar	nd Dwe	elling Unit	s)			\$5,463
Building 121							
24 Hour Auto T-Stat	2	EA	\$32	\$64	\$105	\$210	\$274
Subtotal (Bldg 121)							\$274
Building 128							
24 Hour Auto T-Stat	46	EA	\$32	\$1,472	\$105	\$4,830	\$6,302
Subtotal (Bldg 128)							\$6,302
Building 146							
24 Hour Auto T-Stat	1	EA	\$32	\$32	\$105	\$105	\$137
Time Clock & Wiring	1	EA	\$51	\$51	\$120	\$120	\$171
Subtotal (Bldg 146)							\$308
Buildings 161, 162, 163, 164, 165, 166	6 & 167,	each			<u> </u>	, , , , , , , , , , , , , , , , , , ,	·
24 Hour Auto T-Stat		EA	\$32	\$64	\$105	\$210	\$274
Subtotal (Bldgs 161, 162, 163, 164, 16	65, 166	<u>k</u> 167,	each)		1		\$274
Building 177			•			I	
24 Hour Auto T-Stat	1	EA	\$32	\$32	\$105	\$105	\$137
Subtotal (Bidg 177)					<u> </u>		\$137
Building 178				· · · · · · · · · · · · · · · · · · ·			
Reset Existing Timer	1	EA	\$16	\$16	\$5	\$5	\$21
Subtotal (Bldg 178)							\$21
Building 182			_				
24 Hour Auto T-Stat	1	EA	\$32	\$32	\$105	\$105	\$137
Subtotal (Bldg 182)							\$137
Building 186							
24 Hour Auto T-Stat	2	EA	\$32	\$64	\$105	\$210	\$274
Subtotal (Bldg 186)							\$274
Subtotal, this Sheet, including all build	dings	<u> </u>					645.001
oubtotal, this officer, including all built	ungs		<del></del>				\$15,004

CONSTRUCTION COST ES	TINANT	E		Date Prepared June 1993		SHEET	OF
	HIVIAI	<u> </u>					
Project  EEAP Limited Energy Study				Project No.	Basis for		
Fort Hunter-Liggett, California					Code A	(no design comp	eted)
Engineer-Architect		· · · · · · · · · · · · · · · · · · ·			1		
Keller & Gannon							
Drawing No.		Estimato	r		Checked	Ву	
ECO-B6/7 (T-Clock / Programmable 1	rstat)	RJB	· 1-	1	BIH		
Line Item	No. Units	untity Unit Meas.	Per ' Unit	abor Total	Per Unit	Material Total	Total Cost
Buildings 205, 207, 208, 229 & 230, ea	ach						
24 Hour Auto T-Stat	14	EA	\$32	\$448	\$105	\$1,470	\$1,918
Subtotal (Bldgs 205, 207, 208, 229 &	230, ead	ch)					\$1,918
Building 209		Γ					
24 Hour Auto T-Stat	2	EA	\$32	\$64	\$105	\$210	\$274
Subtotal (Bldg 209)					<u> </u>	·	\$274
Building 212				<u> </u>			<del></del>
24 Hour Auto T-Stat	2	EA	\$32	\$64	\$105	\$210	\$274
Subtotal (Bldg 212)	<del></del>			1	7.00	42.0	\$274
Building 283		<del>   </del>					ΨΕΙΤ
24 Hour Auto T-Stat	1 1	EA	\$32	\$32	\$105	\$105	\$137
Subtotal (Bldg 283)	<del></del> -	-/	402	402	4100	Ψ100	\$137
						:	φ137
Building 290 24 Hour Auto T-Stat	4	EA	\$32	\$128	\$105	\$420	\$548
		LA	φ3 <u>2</u>	\$120	\$105	9420	
Subtotal (Bldg 290)					<u> </u>		\$548
Building 291	2	EA	\$32	\$64	\$105	6010	¢07.4
24 Hour Auto T-Stat		EA	<u> </u>	\$04	\$105	\$210	\$274
Subtotal (Bldg 291)	_						\$274
Building 295	1.55				1		
24 Hour Auto T-Stat	120	EA	\$32	\$3,840	\$105	\$12,600	\$16,440
Subtotal (Bldg 295)					ļ	ļ	\$16,440
Building 301					1		
24 Hour Auto T-Stat	2	EA	\$32	\$64	\$105	\$210	\$274
Subtotal (Bldg 301)					ļ		\$274
					]		
Subtotal, this sheet							\$27,811
Subtotal (ECO B-6/7), all sheets				<b>-</b>			\$42,815
General Conditions 8%							\$3,425
Subtotal							\$46,240
Contractor O.H. & P. 30%							\$13,872
Subtotal							\$60,112
Bond 1%							\$601
Subtotal							\$60,713
Estimating Contingency 10%							\$6,071
Total Probable Construction Cost							\$66,785

ECO B-8

Discrete Port	ECIP Facility Ener tion Name: ECO B	8 Replace Inefficient C	hillers			
	e: June 1993		Economic Life:	15	YEARS	Preparer: KELLER & GANNON
1. Investmen			<u> </u>	_		
A. Construct	ion Costs		\$400,158			
B. SIOH			\$22,009	_		
C. Design Co			\$24,009 \$446,176			
	t (1A+1B+1C)	immant	Φ <del>44</del> 0,170		\$0	
_	alue of Existing Eq				\$19,688	<del></del>
	ity Company Reba stment (1D-1E-1F)				Ψ13,000	 \$426,488
G. Total lilve	sunent (10-12-11)					Ψ120,100
2. Energy Sa	avings (+)/Cost(-):		2			
Date of NIST	1R 85-3273-X Used	for Discount Factors: (	October 1992			
Energy	Cost	Saving	Annual \$		Discount	Discounted
Source	\$/MTBU/(1)	MBTU/YR(2)	Savings(3)		Factor(4)	Savings(5)
A. Elec.	\$21.84	353.7	\$7,724		11.70	\$90,371
B. Dist	\$4.98	0.0	<b>\$</b> 0		13.78	\$0
C. Propane	\$7.87	0.0	<b>\$0</b>		14.16	\$0
D. Demand	\$108.60	<u>164.1</u> kW	/ \$17,821		11.70	\$208,508
E. Other						
F. Total			\$25,545			\$298,880
3. Non Energ	gy Savings (+) or (	Cost (-):		_		
A. Annual Re	ecurring (+/-)		\$0	_		
	Factor (Table A)				11.12	_
(2) Discount	ed Savings/Cost (3	A x 3A1)	. •			\$0
B. Non Recu	ırring Savings (+)	or Cost (-)				
Item	Savings(+)	Year of	Discount		Discounted Sav-	
	Cost(-)(1)	Occur. (2)	Factor(3)		ings(+)Cost(-)(4)	)
a.	\$107,993	3	0.89		\$96,114	_
b.	\$221,264	5	0.82		\$181,437	_
c.	\$30,885	10	0.67		\$20,693	=
d. Total	\$360,142				\$298,243	
C Total Non	Energy Discounted	d Savings (3A2+3Bd4)			\$298,243	
4. Simple Pa	yback 1G/(2F3+3/	A+(3Bd1/Economic Life	·)):		8.6	Years
5. Total Net	Discounted Saving	s (2F5+3C):			\$597,123	
6. Savings to	Investment Ratio				1.40	
7 A allinosa de la	manus Data of Dat	ure (AIDD):			6 269/	

7. Adjusted Internal Rate of Return (AIRR):

6.36%

#### **ECO B8: REPLACE INEFFICIENT CHILLERS**

Many HVAC refrigeration devices (chillers and air conditioners) at Fort Hunter Liggett are inefficient. Energy savings can be achieved by replacing the original systems installed with newer, high efficiency devices. Most of the existing systems were constructed before new efficiency standards were in place. They are aging and many are at the ends of their economic lives.

Replacing existing units with new, high efficiency units is proposed.

#### **Energy Savings**

Electric power consumption of existing units is based on field measurements of equipment operating efficiencies and on computer and manual simulations of building cooling energy use. Refer to EEAP Limited Energy Study for Fort Hunter Liggett, dated 1993 for baseline energy use calculations. Energy savings are determined by considering coefficients of performance (COP) and energy efficiency ratios (EER) of proposed new equipment against those of existing equipment. The electrical power needed to satisfy the same cooling loads with new vs. existing devices is compared. The differences constitute electric power savings.

The COP's and EER's of proposed replacement units are provided by equipment manufacturers for the design conditions at Fort Hunter Liggett.

Both electric power use and demand are lowered by the proposed equipment replacements. Refer to the attached tabular calculations.

#### **Energy Cost Savings**

Annual and life cycle energy cost savings are determined as follows:

**Annual Energy Cost Savings:** 

Electric Use kWH/Yr Saved x 0.003413 MBTU/kWH x \$21.84/MBTU = \$/Yr Saved Electric Demand kW Saved x \$108.60/Year-kW = \$/Yr Saved from demand charges

Life Cycle Energy Cost Savings for economic life of 15 years:

Electric Use \$/Yr Saved x (15 year UPW: 11.70) = LCC \$ Saved Electric Demand \$/Yr Saved x (15 year UPW: 11.70) = LCC \$ Saved

#### **Construction Cost Estimate**

Bare costs are estimated based on equipment manufacturer quotes and on "Means Construction Cost Estimating Guide 1993". Results are provided on the attached cost estimating forms.

Construction cost is determined by applying the following cumulative adders:

General Conditions: 8.0%
Estimating Contingency: 10.0%
Contractor's Overhead and Profit: 30.0%
Bond: 1.0%

#### **ECO B8: REPLACE INEFFICIENT CHILLERS**

Total Cost is determined by adding the following line items to the Construction Cost:

Supervision, Inspection and (Government) Overhead (SIOH): 5.5%
Allowance for Design Services: 6.0%

It is assumed that existing units to be removed have salvage values equal to their disposal costs.

PG&E, the utility company supplying electric power offers a rebate for replacement of inefficient cooling equipment with high efficiency equipment. The rebate depends on device efficiency improvement; rebates for each proposed replacement are shown on the attached tabular calculations.

Investment is determined by subtracting the utility company rebate from the Total Cost.

#### **Operation and Maintenance Cost Savings**

Maintenance costs are assumed the same as for existing equipment.

#### **Avoided Cost of Equipment Replacement**

The economic life of HVAC equipment is set at 15 years for ECIP project evaluations. All the refrigeration devices proposed for replacement will need to be replaced before the end of the project life cycle analysis period. Thus, equipment replacement costs are expensed as a single year cash flow (savings) discounted for the year of occurence. Remaining equipment lifetimes used in economic analysis calculations are based on discussions with maintenance personnel at Fort Hunter Liggett. Refer to the attached tabular calculations.

#### **Economic Analysis**

Total Life Cycle Cost (LCC) Savings: Sum of energy and avoided cost savings.

Simple Payback Period: Investment divided by the sum of annual energy and O&M cost savings.

Savings to Investment Ratio (SIR): Total LCC cost savings divided by the investment.

ECO B8 - Replace Inefficient Chillers

Fac No.	Installation Name	Unit Nominal Tonnage	Existing Clng Usage (KWH/YR)	Existing Unit EER	New Unit EER	New Cing Usage (KWH/YR)	Savings (KWH/YR)	Demand Savings (KW)
P 101	Open Din Cons (Hacienda)	20	3,549	7.5	9.7	2,744	805	7.3
P 128	Officers Quarters Military	25	37,747	7.5	9.7	29,186	8,561	9.1
P 205	Admin General Purpose	80	75,112	8.5	10.6	60,231	14,881	22.4
P 207	Enl Barracks w/o Dining	80	75,112	8.5	10.6	60,231	14,881	22.4
P 208	Enl Barracks w/o Dining	80	79,250	8.5	10.6	63,550	15,700	22.4
P 229	Enl Barracks w/o Dining	80	79,250	8.5	10.6	63,550	15,700	22.4
P 230	Enl Barracks w/o Dining	80	79,250	8.5	10.6	63,550	15,700	22.4
S 290	Electron Equip Facility	25	4,843	7.5	9.3	3,906	937	7.7
P 295	Enl Barracks w/o Dining	54	93,825	8.5	9.8	81,379	12,446	10.1
P 301	ADP Building	60	18,832	8.5	10.8	14,821	4,011	18.0
	TOTALS		546,770			443,147	103,623	164

ECO B8 - Replace Inefficient Chillers

Fac						Single Yea	r Savings	(1)	
No.	Annual	Life Cycle			Total		Year	LCC	Savings
	Cost	Cost	Capitol	PG&E	Invest	Savings	Saving	Savings	Investment
	Savings (\$)	Savings (\$)	Costs (\$)	Rebate	\$	\$	Occurs	\$	Ratio (SIR)
P 101	\$848	\$9,924	\$22,852	\$1,760	\$23,720	\$20,567	3	\$18,304	1.19
P 128	\$1,623	\$18,994	\$24,544	\$2,200	\$25,167	\$22,090	5	\$18,113	1.47
P 205	\$3,539	\$41,408	\$44,261	\$1,120	\$48,231	\$39,835	5	\$32,665	1.54
P 207	\$3,539	\$41,408	\$44,261	\$1,120	\$48,231	\$39,835	5	\$32,665	1.54
P 208	\$3,600	\$42,123	\$44,261	\$1,120	\$48,231	\$39,835	5	\$32,665	1.55
P 229	\$3,600	\$42,123	\$44,261	\$1,120	\$48,231	\$39,835	5	\$32,665	1.55
P 230	\$3,600	\$42,123	\$44,261	\$1,120	\$48,231	\$39,835	5	\$32,665	1.55
S 290	\$911	\$10,655	\$24,451	\$1,800	\$25,463	\$22,006	3	\$19,585	1.19
P 295	\$2,026	\$23,704	\$72,689	\$2,808	\$78,240	\$65,420	3	\$58,224	1.05
P 301	\$2,258	\$26,419	\$34,317	\$5,520	\$32,743	\$30,885	10	\$20,693	1.44
	\$25,545	\$298,880	\$400,158	\$19,688	\$426,488	\$360,142	-	\$298,243	1.40

#### NOTE:

Single year (Non-recurring, non-energy) cost savings represent the avoided cost of replacing units at the ends of their useful lifetimes. Remaining lifetimes, shown by "year of savings" are DEH maintenance worker opinions based on years of experience maintaining the equipment.

				Date Prepared		Sheet of	
CONSTRUCTION COST	ESTI	MATE		June 199	3	355.	
Project				Project No.	Basis for Estim	ate	
EEAP Limited Energy Study				, , , , , , , , , , , , , , , , , , , ,		1410	
Location					Code A (no	design competed	)
Fort Hunter-Liggett, Californi	a						
Engineer-Architect							
Keller & Gannon Drawing No.		Estimato	or		Checked By		
ECO B-8 REPLACE COOLING EQ	UIP.		JCC			BIH	
	Qu	antity		abor	Mater	ial	
Line Item	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	Total Cost
BUILDING 101				•		•	
Demolish existing unit	1	EA	\$750	\$750	-	\$0	\$750
Install 20 ton Air Cooled Unit	1	EA	\$2,400	\$2,400	\$11,500	\$11,500	\$13,900
Subtotal							\$14,650
General Conditions @ 8%							\$1,172
Subtotal							\$15,822
Contractor OH & Profit @ 30%							\$4,747
Subtotal							\$20,569
Bond @ 1%							\$206
Subtotal							\$20,774
Estimating Contingency @ 10%							\$2,077
TOTAL PROBABLE CONSTRUCTI	ON C	OST		*			\$22,852
BUILDING 128						•	
Demolish existing unit	1	EA	\$810	\$810	-	\$0	\$810
Install 25 ton Air Cooled Unit	1	EA	\$2,625	\$2,625	\$12,300	\$12,300	\$14,925
Subtotal							\$15,735
General Conditions @ 8%							\$1,259
Subtotal							\$16,994
Contractor OH & Profit @ 30%							\$5,098
Subtotal							\$22,092
Bond @ 1%							\$221
Subtotal							\$22,313
Estimating Contingency @ 10%							\$2,231
TOTAL PROBABLE CONSTRUCTION	ON C	OST					\$24,544

	FOTI		<del>-</del>	Date Prepared		Sheet of	
CONSTRUCTION COST	ESII	MAIL	•	June 199	93		
Project	-			Project No.	Basis for Estim	ate	
EEAP Limited Energy Study				<u> </u>	0-4-4-4		
Location Fort Hunter Liggett Californ	ia				Code A (no c	design competed	)
Fort Hunter-Liggett, Californ Engineer-Architect	<u> </u>						
Keller & Gannon							
Drawing No.		Estimate			Checked By		
ECO B-8 REPLACE COOLING EC			JCC		177-1	BIH	T
Line Item	No.	antity Unit	Per	abor	Materi Per	lai	Total
	Units	Meas.	Unit	Total	Unit	Total	Cost
BUILDING 205, 207, 208, 229 & 23				· · · · · · · · · · · · · · · · · · ·		,	r
Demolish existing unit	1	EA	\$750	\$750	-	\$0	\$750
Install 80 ton Air Cooled Unit	1 1	EA	\$2,625	\$2,625	\$25,000	\$25,000	\$27,625
Subtotal							\$28,375
General Conditions @ 8%							\$2,270
Subtotal							\$30,645
Contractor OH & Profit @ 30%		ļ					\$9,194
Subtotal							\$39,839
Bond @ 1%							\$398
Subtotal	<u> </u>						\$40,237
Estimating Contingency @ 10%							\$4,024
TOTAL PROBABLE CONSTRUCT	ON C	TSC					\$44,261
BUILDING 290				•			
Demolish existing unit	1	EA	\$750	\$750	-	\$0	\$750
Install 80 ton Air Cooled Unit	1	EA	\$2,625	\$2,625	\$12,300	\$12,300	\$14,925
Subtotal						<u> </u>	\$15,675
General Conditions @ 8%							\$1,254
Subtotal							\$16,929
Contractor OH & Profit @ 30%							\$5,079
Subtotal							\$22,008
Bond @ 1%							\$220
Subtotal			7 - 4				\$22,228
Estimating Contingency @ 10%	<b> </b>						\$2,223
TOTAL PROBABLE CONSTRUCTI	ON C	ÖST		L		L	\$24,451

				Date Prepared		Sheet of	
CONSTRUCTION COST	ESTI	MATE	_	June 199	93	Onlock Of	
				Project No.	Basis for Estim		
Project EEAP Limited Energy Study				Project No.	Dasis IOI Estilli	ara	
Location Limited Energy Study				<u> </u>	Code A (no d	lesign competed	)
Fort Hunter-Liggett, Californi	а						
Engineer-Architect					1		
Keller & Gannon							
Drawing No.	שווח	Estimate			Checked By	DILL	
ECO B-8 REPLACE COOLING EQ		antity	JCC	abor	Materi	BIH	
Line Item	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	Total Cost
BUILDING 295	<u> </u>			•			·
Demolish existing unit	1	EA	\$1,250	\$1,250	-	\$0	\$1,250
Install 80 ton Air Cooled Unit	1	EA	\$6,450	\$6,450	\$38,900	\$38,900	\$45,350
Subtotal							\$46,600
General Conditions @ 8%							\$3,728
Subtotal							\$50,328
Contractor OH & Profit @ 30%							\$15,098
Subtotal							\$65,426
Bond @ 1%							\$654
Subtotal	1						\$66,081
Estimating Contingency @ 10%							\$6,608
TOTAL PROBABLE CONSTRUCTI	ON C	OST			•	•	\$72,689
BUILDING 301							
Demolish existing unit	1	EA	\$1,000	\$1,000	-	\$0	\$1,000
Install 80 ton Air Cooled Unit	1	EA	\$2,100	\$2,100	\$18,900	\$18,900	\$21,000
Subtotal			!			-	\$22,000
General Conditions @ 8%							\$1,760
Subtotal							\$23,760
Contractor OH & Profit @ 30%							\$7,128
Subtotal							\$30,888
Bond @ 1%				7.5.7.45.20			\$309
Subtotal							\$31,197
Estimating Contingency @ 10%				7.4.4.1			\$3,120
TOTAL PROBABLE CONSTRUCTI	ON CO	DST	****		•		\$34,317

ECO B10

Location: Project Title:	Fort Hunter Ligg	gett, California nergy Improvements	Region No. 4		Project No. Fiscal Year FY95
	ion Name: ECO B		Flue Dampers on Heati Economic Life:	ng System Boilers 15 YEARS	Preparer: KELLER & GANNO
1. Investment	t Costs				
A. Constructi	on Costs		\$13,059		
B. SIOH			\$718		
C. Design Co	st		\$784		
D. Total Cost	(1A+1B+1C)		\$14,561		
E. Salvage Va	alue of Existing E	quipment		\$0	
F. Public Utili	ty Company Reba	ate		\$0	_
G. Total Inves	stment (1D-1E-1F)	)			\$14,561
2 Energy Sa	vings (+)/Cost(-):				
Date of NIST	R 85-3273-X Used	d for Discount Factor	s: October 1992		
Energy	Cost	Saving	Annual \$	Discount	Discounted
Source	\$/MTBU/(1)	MBTU/YR(2)	Savings(3)	Factor(4)	Savings(5)
A. Elec.	\$21.84	0.0	\$0	11.70	\$0
B. Dist	\$4.98	282.8	\$1,408	13.78	\$19,408
C. Propane	\$7.87	174.3	\$1,372	14.16	\$19,423
D. Demand	\$108.60	0.0	kW \$0	11.70	\$0
E. Other					
F. Total		457.1	\$2,780		\$38,830
3. Non Energ	y Savings (+) or	Cost (-):			
A. Annual Re	curring (+/-)		\$0		
(1) Discount I	Factor (Table A)			11.12	
(2) Discounte	ed Savings/Cost (	3A x 3A1)			<b>\$</b> 0
B. Non Recu	rring Savings (+)	or Cost (-)			
ltem	Savings(+)	Year of	Discount	Discounted Sav-	
	Cost(-)(1)	Occur. (2)	Factor(3)	ings(+)Cost(-)(4)	
a.					
b.			•		
C.			•		
d. Total					
C Total Non I	Energy Discounte	d Savings (3A2+3Bo	14)	\$0	
4. Simple Pay	/back 1G/(2F3+3	A+(3Bd1/Economic	Life)):	5.2	Years
	Discounted Saving			\$38,830	
6. Savings to	Investment Ratio	(SIR) 5/1G:		2.67	
7. Adjusted In	nternal Rate of Re	turn (AIRR):		11.03%	

# ECO B10: INSTALL AUTOMATIC FLUE DAMPERS ON HEATING SYSTEM BOILERS

This measure is developed to evaluate the potential energy savings created by the installation of an automatic damper which closes off the flue whenever the burner has completed a firing cycle.

During normal operations, about 2% to 3% of boiler fuel use is lost through the flue between burner firing cycles.

#### **Energy Savings Calculations**

Energy savings are achieved by raising the boiler/heater efficiency by about 1.5%. Fuel savings are determined based on baseline fuel use and existing boiler efficiencies. Baseline energy use and system efficiency determinations are provided in: "EEAP Limited Energy Study for Fort Hunter Liggett", dated 1993. Savings are calculated as follows:

 $Qs = Qo - Qo \times Efficiency / (Efficiency + 1.5\%)$ 

where: Qs = Fuel Savings

Qo = Baseline fuel use (after reduction of domestic hot water

temperatures to authorized levels)

Efficiency Baseline system efficiency

Annual energy cost savings are based on fuel savings calculations as explained above:

Propane MBTU/Yr Saved x \$ 7.87/MBTU = \$/Yr Saved Fuel Oil MBTU/Yr Saved x \$ 4.98/MBTU = \$/Yr Saved

Life Cycle Energy Cost Savings for economic life of 15 years:

Propane \$/Yr Saved x (15 year UPW: 14.16) = LCC \$ Saved Fuel Oil \$/Yr Saved x (15 year UPW: 13.78) = LCC \$ Saved

#### **Construction Cost Estimate**

Bare costs are estimated based on "Means Construction Cost Estimating Guide 1993". Results are provided on the attached cost estimating forms.

Construction cost is determined by applying the following cumulative adders to bare costs:

General Conditions:8.0%Estimating Contingency:10.0%Contractor's Overhead and Profit:30.0%Bond:1.0%

Investment is determined by adding the following separate factors of the construction cost:

Supervision, Inspection and (Government) Overhead (SIOH): 5.5%
Allowance for Design Services: 6.0%

#### **Economic Analysis**

Total Life Cycle Cost (LCC) Savings: Sum of energy and O&M LCC costs savings. Simple Payback Period: Investment divided by the sum of annual energy and O&M cost savings. Savings to Investment Ratio (SIR): Total LCC cost savings divided by the investment.

ECO B10 INSTALL AUTOMATIC FLUE DAMPERS ON HEATING SYSTEM BOILERS

Fac		No. of	No. of ECO B10 Energy Savings: Automatic Flue Dampers	nergy Sav	ings: Auto	matic Flue	Dampers						
ġ Ż	Installation Name	Flues	Electric	Propane	Fuel Oil	Electric	Propane	Fuel Oil	\$ CCC	Constr	Investment	Payback	SIR
		& Dia	kWH/Yr	Mil BTU/Y	MII BTU/Y MII BTU/Y	\$/Yr	\$/Yr	\$/Yr	Saved	Cost		Years	
P 101	Open Din Cons (Hacienda)	2 x 8"	•	23.5	•	•	\$184.99	•	\$2,619	\$1,136	\$1,267	6.85	2.07
00,	Club (Bar)	,		7			77		200	000	000	ļ	
2 -	Fire Station - Unice	× č	•	<u></u>	•	•	\$123.44	•	41,748	Z80,1¢	auz,1¢	2.6	 C4.
	Fire Station - Dorm	<u>ه</u>											
	Fire Station - Garage												
P 128	Officers Quarters Military	.8	-	13.1	•	•	\$102.99	-	\$1,458	\$568	\$633	6.15	2.30
S 197	Admin Bldg R&D - Office	.9	•	2.2	•	•	\$44.87	•	\$635	\$541	E09\$	13.44	1.05
	Admin Bldg R&D - Electronics												
P 205	Admin General Purpose	.8	•	•	28.2	•	•	\$140.25	\$1,933	\$582	\$649	4.63	2.98
P 205A	P 205A Company HQ Building												
P 206	Enlisted Pers Dining Fac	2 x 8"		•	81.8		•	\$407.38	\$5,614	\$1,164	\$1,298	3.19	4.33
	Kitchen Area - Scullery	-											
P 207	Enl Barracks w/o Dining	8	•	•	28.3	•	•	\$140.90	\$1,942	\$285	\$649	4.61	2.99
P 207A													
P 208	Enl Barracks w/o Dining	8	•	•	28.0	•	•	\$139.49	\$1,922	\$585	\$649	4.65	2.96
P 208A													
P 210	Hith/Dntl Clinic w/ Beds	.8	1	•	21.5	•	•	\$106.94	\$1,474	\$285	\$649	6.07	2.27
P 211	Outdoor Swimming Pool	8	•	27.2	•	•	\$214.28	•	\$3,034.	\$268	\$633	2.96	4.79
P 212	Gymnasium		-	16.5	•	•	\$129.83	-	\$1,838	\$541	\$603	4.65	3.05
P 219	Physical Fitness Center	.8	•	9.4	•	•	\$74.16	•	\$1,050	\$568	\$633	8.54	1.66
P 229	Enl Barracks w/o Dining	ъ	•	•	28.1	•	•	\$139.87	\$1,927	285\$	\$649	4.64	2.97
P 229A													
P 230		<u></u>	•	•	28.4	•	1	\$141.35	\$1,948	\$285	\$649	4.59	3.00
P 230A	Company HQ Building												
\$ 238	Sig Photo Lab	4	•	10.8	1		\$85.17	•	\$1,206	\$531	\$592	6.95	2.04
	Process												
P 252	Vehicle Maint Shop DS		•	-	18.5	1	•	\$92.11	\$1,269	\$582	\$649	7.05	1.96
P 259	Vehicle Maint Shop ORG	8"	•	•	20.1	•	•	\$100.11	\$1,379	\$285	\$649	6.48	2.13
S 290	Electron Equip Facility	₩.	•	17.4	•	•	\$137.19	•	\$1,943	\$568	\$633	4.62	3.07
\$ 291	Cont Humid Warehouse	- To	•	9 4	•		\$74.03	•	\$1,048	\$568	\$633	8.55	1.66
P 295	Enl Barracks w/o Dining	8	·	25.5	•		\$200.71	•	\$2.842	\$568	\$633	3.16	4.49
TOTALS			00	1743	282.8	O\$	\$1372	\$1 408	\$38,830	\$13,059	\$14.561	5.24	2.67
													,

		_		Date Prepared		Sheet (	OF .
CONSTRUCTION COST ES	TAMIT	E		June 1993	3		
Project				Project No.	Basis for	Estimate	
EEAP Limited Energy Study							
Location					Code A	(no design compe	eted)
Fort Hunter-Liggett, California					1		
Engineer-Architect Keller & Gannon							
Drawing No.		Estimato	r		Checked	Ву	
ECO-B10 Install Automatic Flue Dam	pers		RJB			BIH	
	Qu	antity		lbor		Material	
Line Item	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	Total Cost
GAS FIRED HEATERS							
4-inch Diameter Auto-Damper	1	Ea	32.00	\$32	\$134	\$134	\$166
Relay & Wiring	-	Job	-	\$120	-	\$60	\$180
Subtotal 4-inch Flue, Gas Fired							\$346
General Conditions 8%							\$28
Contractor O.H. & P 30%					1		\$104
Sub Total							\$478
Bond 1%							\$5
Sub Total							\$483
Estimating Contingency 10%							\$48
Total Probable Construction Cost							\$531
100011100000000000000000000000000000000							
6-inch Diameter Auto-Damper	1	Ea	34.90	\$35	\$138	\$138	\$173
Relay & Wiring	<del>-</del>	Job	-	\$120	-	\$60	\$180
Subtotal 6-inch Flue, Gas Fired					<u> </u>		\$353
General Conditions 8%							\$28
Contractor O.H. & P 30%						<del>                                     </del>	\$106
Sub Total			· · · · · · · · · · · · · · · · · · ·				\$487
Bond 1%							\$5
Sub Total							\$492
Estimating Contingency 10%			-				\$49
Total Probable Construction Cost							\$541
							ΨΟΤΙ
8-inch Diameter Auto-Damper	1	Ea	38.40	\$38	\$152	\$152	\$190
Relay & Wiring	<del>-</del>	Job	-	\$120	-	\$60	\$180
Subtotal 8-inch Flue, Gas Fired				7.20		+ + + + + + + + + + + + + + + + + + + +	\$370
General Conditions 8%					<u> </u>		\$30
Contractor O.H. & P 30%			- y T,				\$111
Sub Total				1.0			\$511
Bond 1%							\$5
Sub Total							<del>Ψ</del> \$516
Estimating Contingency 10%							
Total Probable Construction Cost							\$52 \$56
TOTAL PRODUCTION COST	- 1	ı l			l		\$568

CONSTRUCTION COST EST	ΤΙΜΔΤ	F		Date Prepared June 1993		Sheet C	)F	
	11141/7.1			Project No.	Basis for	Estimate		
Project				Project No.	Dasis IOI	Estimate		
EEAP Limited Energy Study				<u>.                                    </u>	Code A	(no design compe	ted)	
Fort Hunter-Liggett, California								
Engineer-Architect					1			
Keller & Gannon					ļ			
Drawing No.		Estimato			Checked	•		
ECO-B10 Install Automatic Flue Damp		antity	RJB	abor		BIH Material		
Line Item	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	Total Cost	
OIL FIRED HEATERS								
4-inch Diameter Auto-Damper	1	Ea	32.00	\$32	\$156	\$156	\$188	
Relay & Wiring	-	Job	•	\$120	-	\$60	\$180	
Subtotal 4-inch Flue, Oil Fired							\$368	
General Conditions 8%							\$29	
Contractor O.H. & P 30%							\$29	
Sub Total							\$426	
Bond 1%							\$4	
Sub Total							\$431	
Estimating Contingency 10%							\$43	
otal Probable Construction Cost						\$474		
6-inch Diameter Auto-Damper	1	Ea	34.90	\$35	\$161	\$161	\$196	
Relay & Wiring	<b>-</b>	Job	_	\$120	-	\$161 \$161 - \$60		
Subtotal 6-inch Flue, Oil Fired	<b>-</b>							
General Conditions 8%	<u> </u>				<u> </u>	\$30		
Contractor O.H. & P 30%				1			\$113	
Sub Total							\$519	
Bond 1%							\$5	
Sub Total							\$524	
Estimating Contingency 10%							\$52	
Total Probable Construction Cost							\$576	
					<u> </u>		+	
8-inch Diameter Auto-Damper	1	Ea	38.40	\$38	\$161	\$161	\$199	
Relay & Wiring	<b>-</b>	Job	•	\$120	-	\$60	\$180	
Subtotal 8-inch Flue, Oil Fired							\$379	
General Conditions 8%							\$30	
Contractor O.H. & P 30%	1						\$114	
Sub Total					1		\$524	
Bond 1%	1						\$5	
Sub Total					1		\$529	
	_1	II		1			7020	
Estimating Contingency 10%		1					\$53	

#### ECO B15

# Life Cycle Cost Analysis Summary Energy Conservation Investment Program (ECIP)

Location: Project Title	Fort Hunter Ligg : ECIP Facility Er	gett, California nergy Improvements	Region No. 4		Project No. Fiscal Year FY95
Discrete Por		ECO B15 Conv	ert Multizone HVAC S	•	
Analysis Da	te: June 1993		Economic Life: 1	15 YEARS	Preparer: KELLER & GANNON
1. Investmer	nt Costs				
A. Construc			\$122,292		
B. SIOH			\$6,726		
C. Design C	ost		\$7,338		
	st (1A+1B+1C)		\$136,355		
	Value of Existing E	auipment	,	\$0	
_	ility Company Reb			\$0	_
	estment (1D-1E-1F				\$136,355
2 Energy S	avings (+)/Cost(-):				
		d for Discount Facto	ors: October 1992		
Energy	Cost	Saving	Annual \$	Discount	Discounted
Source	\$/MTBU/(1)	MBTU/YR(2)	Savings(3)	Factor(4)	Savings(5)
A. Elec.	\$18.23	863.6	\$15,743	11.70	\$184,188
B. Dist	\$4.98	0	\$0	13.78	<b>\$</b> 0
C. Propane	\$7.87	0	<del></del> \$0	14.16	<b>\$</b> 0
D. Other	NA		<del></del> \$0	NA	NA
E. Demand	Savings		= \$0	11.70	<b>\$</b> 0
F. Total		864	\$15,743		\$184,188
3. Non Ener	gy Savings (+) or	Cost (-):	· · · · · ·	•	
A. Annual R	ecurring (+/-)		(\$1,000)		
	t Factor (Table A)			11.12	
` '	ted Savings/Cost (	3A x 3A1)			(\$11,120)
B. Non Rec	urring Savings (+)	or Cost (-)			
Item	Savings(+)	Year of	Discount	Discounted Sav-	
	Cost(-)(1)	Occur. (2)	Factor(3)	ings(+)Cost(-)(4)	
a.	\$0	15	0.56	\$0	
	\$0	15	0.56	\$0	
b.	ΨΟ				
	\$0	15	0.56	\$0	
b. c. d. Total			0.56	\$0 \$0	
c. d. Total	\$0 \$0	15	0.00		
c. d. Total C Total Non	\$0 \$0 Energy Discounte	15 0	0.00	\$0	Years
<ul><li>c.</li><li>d. Total</li><li>C Total Non</li><li>4. Simple Page</li></ul>	\$0 \$0 Energy Discounte	15 0 ed Savings (3A2+3B	0.00	\$0 (\$11,120)	Years
<ul><li>c.</li><li>d. Total</li><li>C Total Non</li><li>4. Simple Pa</li><li>5. Total Net</li></ul>	\$0 \$0 Energy Discounte	15 0 ed Savings (3A2+3B 9A+(3Bd1/Economic gs (2F5+3C):	0.00	\$0 (\$11,120) 9.25	Years

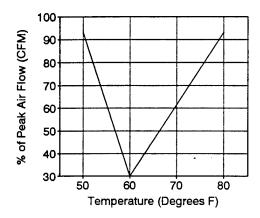
# ECO B15: CONVERT MULTIZONE HVAC SYSTEMS TO VARIABLE AIR VOLUME

Large barracks buildings 205, 207, 208, 229 and 230 are served by dual duct, multizone central HVAC systems. Operation of hot and cold decks simulataneously has been precluded by a past controls modification. The existing controls allow simultaneous operation in only the heating or cooling mode.

#### **Energy Savings Calculations**

Energy savings can be achieved by removing existing dual duct mixing boxes and controls and replacing them with variable air volume boxes and controls. Energy savings are achieved by scheduling constant temperature supply air at air flow rates corresponding to the heating or cooling load.

As shown below, the variable air volume system saves fan energy during all times of the year except when the system is at full load heating or cooling mode. (Note: Air flow rates are proportional to fan power.)



Barracks buildings are assumed to be dominated by external HVAC loads. Thus, the required air flow will track with the outside air temperature.

The following schedule is derived from local weather data to approximate the air flow rates to be provided by the VAV system during different outside air temperatures ranges.

Temperature	Percent of	Percent of	VAV Fan Load
Range	Total CFM	Year at Load	per Temp Range
over 80 Degrees	100%	7%	7%
60 to 80 Degrees	80%	52%	42%
30 to 50 Degrees	40%	40%	16%
below 30 Degrees	100%	1%	1%
Weighted average VAV Fan Energ	y of Existing Us	e:	66%

Only fan energy is saved, thus, baseline fan energy use is reduced to 66% of the existing system use. Refer to attached tabular calculations.

Annual energy cost savings are based on fuel savings calculations as explained above:

Electricity

kWH/Yr Saved x 0.003413 MBTU/kWH x \$18.23/MBTU = \$/Yr Saved

**ECO B15:** 

# CONVERT MULTIZONE HVAC SYSTEMS TO VARIABLE AIR VOLUME

Life Cycle Energy Cost Savings for economic life of 15 years:

Electricity

\$/Yr Saved x (15 year UPW: 11.70) = LCC \$ Saved

#### **Construction Cost Estimate**

Bare costs are estimated based on "Means Construction Cost Estimating Guide 1993". Results are provided on the attached cost estimating forms.

Construction cost is determined by applying the following cumulative adders to bare costs:

General Conditions: 8.0%
Estimating Contingency: 10.0%
Contractor's Overhead and Profit: 30.0%
Bond: 1.0%

Investment is determined by adding the following separate factors of the construction cost:

Supervision, Inspection and (Government) Overhead (SIOH): 5.5%
Allowance for Design Services: 6.0%

#### **Economic Analysis**

Total Life Cycle Cost (LCC) Savings: Sum of energy and O&M LCC costs savings. Simple Payback Period: Investment divided by the sum of annual energy and O&M cost savings. Savings to Investment Ratio (SIR): Total LCC cost savings divided by the investment.

ECO - B15 Convert Multizone HVAC System to Variable Air Volume

Constr. Investment Pay- SIR	\$ Back	SR \$27 271 R Q5 1 31	451,51	\$27,271	\$27,271	\$27,271 \$27,271 \$27,271	\$27,271 9.34 \$27,271 9.34 \$27,271 8.49 \$27,271 10.32
	LCC\$ Cost \$	(\$2,224) \$24,458		(\$2,224) \$24,458	(\$2,224) \$24,458 (\$2,224) \$24,458	(\$2,224) \$24,458 (\$2,224) \$24,458 (\$2,224) \$24,458	(\$2,224) \$24,458 (\$2,224) \$24,458 (\$2,224) \$24,458 (\$2,224) \$24,458
Savings Energy Cost Saved O&M Cost Saved	\$/Yr LC	(\$200) (\$2,	֡֡֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜֜	(\$200) (\$2,			
ost Saved C	\$227	\$3,246 \$37,973		\$36,513	\$36,513 \$36,513	\$36,513 \$36,513 \$39,921	
Energy C	r \$/Yr			\$3,121			<del></del>
Savings	kW hr / Yr	52,164		50,158	50,158 50,158	50,158 50,158 54,839	50,158 50,158 54,839 45,699
Full Load VAV System	kW hr / Yr.	101,260		97,365	97,365	97,365 97,365 106,453	97,365 97,365 106,453 88,710
Full Load	kW hr / Yr	153,424		147,523	147,523 147,523	147,523 147,523 161,292	
Fan Amps	No. SA Fan RA Fan kw hr / Yr kw hr / Yr.	55 23		54 21			
Fac. F	No.	205		207	207	207 208 229	207 208 229 230

Annual Full Load Energy Consumption was calculated from measured phase voltage readings and operating hours of the building.

Full load kWHr / Year consumption of supply and return fans are reduced to 66% of existing usage due to the proposed VAV retrofit.

Energy cost savings are based on the year-round, continuous usage rate for power.

Annual O&M efforts for VAV system components are expeced to require an additional 5 MH per year of effort. At \$40 per hour, annual cost per building VAV sytem is \$200.

	13.4.A.T	_		Date Prepared		Sheet Of	
CONSTRUCTION COST EST	IMAI			June 1993			
Project				Project No.	Basis for	Estimate	
EEAP Limited Energy Study				<u> </u>	Code A	/no doning comm	atad\
Location					Code A	(no design comp	elea)
Fort Hunter-Liggett, California Engineer-Architect							
Keller & Gannon							
Drawing No.		Estimate			Checked	•	
ECO-B9 Convert Multizone to VAV			JCS			BIH	
Line Item	No. Units	Unit Meas.	Per Unit	Labor Total	Per Unit	Aaterial Total	Total Cost
Buildings 205, 207, 208, 229 & 230 (Typ	ical fo	r Eacl	ר)	· · · · · · · · · · · · · · · · · · ·	1	T	
		-	****	00.400	0050	<b>AT 000</b>	<b>A7.00</b>
Double-Duct VAV Box with T-stat	8	EA	\$300	\$2,400	\$650	\$5,200	\$7,600
and duct static pressure sensor		ļ <u>.</u>			ļ		
20 HP Variable Frequency Drive	1	LS	-	\$1,200	-	\$3,000	\$4,200
installed w/ actuator							
Remove Constant Volume Mixing Boxe	8	LF	\$250	\$2,000	-	\$0	\$2,000
Testing and Balancing	1	LS	_	-	_	_	\$1,88
resting and balancing	<u> </u>		<u>.                                    </u>				<del>+ 1,00</del>
	<u> </u>						
			·				
					t		
		<u> </u>					
		<b>-</b>			1		
					<del> </del>		
	<del> </del>	<del>                                     </del>					
			-				
Subtotal							\$15,68
General Conditions @ 8%	<del>                                     </del>				† <del></del>	t	\$1,25
Subtotal						1	\$16,93
Contractor OH & Profit @ 30%						<u> </u>	\$5,08
Subtotal					1		\$22,01
Bond @ 1%			<del>                                     </del>	<del></del>			\$22
Subtotal							\$22,23
Estimating Contingency @ 10%							\$2,22
Total Probable Construction Cost	<b></b>						\$24,45
, 5.2. 1 1052510 0011011 2011011 0001	1	<del>                                     </del>	ļ	<del></del>	ļ		<del>+- 1, 70</del>

Region No. 4

ECO B21

Project No.

Location: Project Title:	Fort Hunter Ligg ECIP Facility Ene	rgy Improvements	Region No. 4			Project No. Fiscal Year FY95
Discrete Porti Analysis Date		21 Replace Inefficie	Economic Life	: 15	YEARS	Preparer: KELLER & GANNON
E. Salvage Va F. Public Utili	on Costs	ate	\$28,061 \$1,543 \$1,684 \$31,288		\$0 \$0	 \$31,288
2. Energy Sar Date of NISTI	vings (+)/Cost(-): R 85-3273-X Used	d for Discount Facto	rs: October 1992	<u>-</u>		
Energy Source	Cost \$/MTBU/(1)	Saving MBTU/YR(2)	Annual \$ Savings(3)		Discount Factor(4)	Discounted Savings(5)
A. Elec. B. Dist C. Propane D. Demand E. Other F. Total	\$21.84 \$4.98 \$7.87 \$108.60	0.0 0.0 506.1 0.0	\$0 \$0 \$3,983 kW \$0 	<u>.</u>	11.70 13.78 14.16 11.70	\$0 \$0 \$56,397 \$0 \$56,397
3. Non Energ	y Savings (+) or	Cost (-):				
(2) Discounte	curring (+/-) Factor (Table A) d Savings/Cost ( rring Savings (+)		\$0		11.12	\$0
Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)		Discounted Sav- ings(+)Cost(-)(4)	
a. b. c. d. Total				- 		- - -
C Total Non	Energy Discounte	ed Savings (3A2+3B	d4)		\$0	
5. Total Net I 6. Savings to	yback 1G/(2F3+3 Discounted Saving Investment Ratio Internal Rate of Re	(SIR) 5/1G:	: Life)): ·		7.9 \$56,397 1.80 8.17%	Years

#### ECO B21: REPLACE INEFFICIENT BOILERS

This measure is developed to evaluate the potential energy savings created by the replacement of older, low efficiency boilers with new, high efficiency boilers.

#### **Energy Savings Calculations**

Energy savings are achieved by raising the boiler/heater efficiency. Fuel savings are determined based on baseline fuel use and the difference between existing and proposed new boiler efficiencies. Baseline energy use and system efficiency determinations are provided in: "EEAP Limited Energy Study for Fort Hunter Liggett", dated 1993. Savings are calculated as follows:

Qs = Qo x (Existing Efficiency / (New Efficiency)

where: Qs = Fuel Savings

Qo = Baseline fuel use (after implimentation of envelope and HVAC ECO's

with SIR's over 1.0)

Efficiency System efficiencies for existing and new boilers

Annual energy cost savings are based on fuel savings calculations as explained above:

Propane MBTU/Yr Saved x \$ 7.87/MBTU = \$/Yr Saved Fuel Oil MBTU/Yr Saved x \$ 4.98/MBTU = \$/Yr Saved

Life Cycle Energy Cost Savings for economic life of 15 years:

Propane \$/Yr Saved x (15 year UPW: 14.16) = LCC \$ Saved Fuel Oil \$/Yr Saved x (15 year UPW: 13.78) = LCC \$ Saved

#### **Construction Cost Estimate**

Bare costs are estimated based on "Means Construction Cost Estimating Guide 1993". Results are provided on the attached cost estimating forms.

Construction cost is determined by applying the following cumulative adders to bare costs:

General Conditions: 8.0% - Estimating Contingency: 10.0% Contractor's Overhead and Profit: 30.0% Bond: 1.0%

Investment is determined by adding the following separate factors of the construction cost:

Supervision, Inspection and (Government) Overhead (SIOH): 5.5% Allowance for Design Services: 6.0%

#### **Economic Analysis**

Total Life Cycle Cost (LCC) Savings: Sum of energy and O&M LCC costs savings.

Simple Payback Period: Investment divided by the sum of annual energy and O&M cost savings.

Savings to Investment Ratio (SIR): Total LCC cost savings divided by the investment.

ECO B21: REPLACE INEFFICIENT BOILERS

Fac		Boiler System Data	tem Data		Existing	Boiler	Existing Boiler System Losses	Sesso			
ģ	nstallation Name	Fuel	System	Capacity	Firing	Auxil-	Radiant	Firing Auxil- Radiant Convec- Shut Genri	Shut	Genri	Net
		Dsed	Туре	втин	Ħ	liary		tion	tion Down Cond	Cond	ŧ
		•									
P 101	Open Din Cons Hacienda	Propane	Propane AHU-HWB/C	300,000 82.9%	85.9%	•	%0'9	4.0% 2.0% 3.0% 67.9%	2.0%	3.0%	67.9%
	Clu Bar										
	Hacienda, Dwellings	Electric	ER-PH	30 x 3kW	•		,	•	٠	•	
S 290	Electron E uip Facility	Propane	Propane AHU-PROP/C	1,020,000 80.8%	80.8%	٠	8.0%	4.0% 2.0% 3.0% 63.8%	2.0%	3.0%	63.8%
P 642	Detached Latrine/Shower	Propane	Propane HWH/TK-Circ	180,000 75.2%	75.2%	•	7.0%	4.0% 2.0% 3.0%	2.0%	3.0%	59.2%

ECO B21: REPLACE INEFFICIENT BOILERS

Fac	:	New Boile	iler Syst	er System Losses	98				Econom	Economic Analysis	"					
Š	Installation Name	Firing	Auxil-	Radiant	Auxil- Radiant Convec- Shut Gend Net	Shut	Genn	Net	E	Energy Energy Annual	Energy	Annual	227	Constr	Invest-	, 1 <del>4-11</del>
		盂	liary		tion	Down Cond	Cond	ŧ	Added	Usage Savings	Savings	Cost	Saved	Cost	ment	- · · · · · · · · · · · · · · · · · · ·
										MBtu/Yr	MBtu/Yr	MBtu/Yr MBtu/Yr Saved \$	₩	\$	↔	SIR
ē	en Din Cons acienda	94.0%	'	4.0%	2.0%	2.0%	1.0%	85.0%	2.0% 1.0% 85.0% 17.1%	1,064.0		214 \$1,685	\$23,854	\$6,941	\$7,739	3.1
	Clu Bar															
	acienda, Dwellings	-			٠	-	-	-								
S 290	Electron E ui Facility	94.0%		4.0%	2.0%	2.0%	1.0%	2.0% 1.0% 85.0% 21.2%	21.2%	741.5		185 \$1,455	\$20,609	\$20,609 \$15,793 \$17,609	\$17,609	1.2
642	Detached Latrine/Shower	0.94		0.04	0.02	2.0%	1.0%	1.0% 85.0% 25.9%	25.9%	116.7	107	\$843	\$11,934	\$5,327	\$5,940	2.0
							Totale				506	506 \$3 083	\$56 307	456 307 \$28 061 \$31 288	\$31 288	× ×

		_		Date Prepared		Sheet Of	
CONSTRUCTION COST EST	IMAT	E		June 19	93		
Project				Project No.	Basis for Esti	mate	
EEAP Limited Energy Study						4	n
Location					Code A (no	design competed	1)
Fort Hunter-Liggett, California Engineer-Architect					1		
Keller & Gannon							
Drawing No.		Estimato	or		Checked By		
ECO B21 REPLACE INEFFICIENT BOIL	.ERS						
I to a Marie	Qu No.	antity Unit	La Per	bor	Mate Per	rial T	Total
Line Item	Units	Meas.	Unit	Total	Unit	Total	Cost
BUILDING 101		<u> </u>			<u> </u>		
Demolish existing boiler	1	EA	\$750	\$750		\$0	\$750
Provide & Install 300,000 BTUH Boiler	1	EA	\$1,050	\$1,050	\$2,650	\$2,650	\$3,700
Subtotal							\$4,450
General Conditions @ 8%							\$356
Subtotal							\$4,806
Contractor OH & Profit @ 30%							\$1,442
Subtotal							\$6,248
Bond @ 1%							\$62
Subtotal							\$6,310
Estimating Contingency @ 10%							\$631
Total Probable Construction Cost		<u> </u>	L	<u> </u>			\$6,941
Total House College							·
	<u> </u>	<u> </u>					·
	<u> </u>						
BUILDING 290	1	·	l		<del>- L</del>	<u></u>	
Demolish existing boiler	1	EA	\$1,200	\$1,200		\$0	\$1,200
Provide & Install 1,020,000 BTUH Boile	<del></del>	EA	\$1,675	\$1,675		\$7,250	\$8,925
Subtotal							\$10,125
General Conditions @ 8%							\$810
Subtotal							\$10,935
Contractor OH & Profit @ 30%							\$3,281
Subtotal			<u> </u>				\$14,216
Bond @ 1%							\$142
Subtotal							\$14,358
Estimating Contingency @ 10%	1						\$1,436
Total Probable Construction Cost					-	•	\$15,793

CONSTRUCTION COST EST	IMAT	E		Date Prepared June 19	93	Sheet Of	
Project				Project No.	Basis for Esti	mate	
EEAP Limited Energy Study							
Location					Code A (no	design competed	)
Fort Hunter-Liggett, California					_		
Engineer-Architect							
Keller & Gannon		Estimato	NP.		Checked By		
Drawing No.	EDQ	Laumate	<b>,</b>		Ciliconda Dy		
ECO B21 REPLACE INEFFICIENT BOIL		antity	La	abor	Mate	orial	
Line Item	No. Unit Per Units Meas. Unit -			Total	Per Unit	Total	Total Cost
BUILDING 642				<b>.</b>			
Demolish existing boiler	1	EA	\$750	\$750		\$0	\$750
Provide & Install 180,000 BTUH Boiler	1	EA	\$840	\$840	\$1,825	\$1,825	\$2,665
Subtotal							\$3,415
General Conditions @ 8%							\$273
Subtotal							\$3,688
Contractor OH & Profit @ 30%							\$1,106
Subtotal							\$4,795
Bond @ 1%							\$48
Subtotal							\$4,843
Estimating Contingency @ 10%							\$484
Total Probable Construction Cost							\$5,327

### ECO C2

# Life Cycle Cost Analysis Summary Energy Conservation Investment Program (ECIP)

Location: Project Title:	ECIP Facility E	ggett, California nergy Improvemer	Region No. 4 nts sulation on Domestic	F	roject No. ïscal Year FY95	
Analysis Date:		2 neplace ripe ili	Economic Life: 1	15 YEARS P	reparer: KELLER & GANN	ON
1. Investment C						
A. Construction	Costs		\$655			
B. SIOH			\$36			
C. Design Cost			\$39			
D. Total Cost (1			\$730	•		
E. Salvage Valu		quipment		\$0		
F. Public Utility				\$0	<u></u>	
G. Total Investr					\$730	
	(1)(0)(4)					
2. Energy Savir Date of NISTIR	ngs (+)/Cost(-): 85-3273-X Used	d for Discount Fac	tors: October 1992			
Energy	Cost	Saving	Annual \$	Discount	Discounted	
Source	\$/MTBU/(1)	MBTU/YR(2)	Savings(3)	Factor(4)	Savings(5)	
A. Elec.	\$21.84	0.0	\$0.00	11.70	<b>\$</b> 0	
B. Dist	\$4.98	35.1	\$174.80	13.78	\$2,409	
C. Propane	\$7.87	14.9	\$117.26	14.16	\$1,660	
D. Demand	\$108.60	0.0 k\	N \$0.00	11.70	<b>\$</b> 0	
E. Other						
F. Total			\$292.06		\$4,069	
3. Non Energy	Savings (+) or	Cost (-):				
A. Annual Recu	ırring (+/-)		\$0			
(1) Discount Fa	ctor (Table A)			11.12		
(2) Discounted	Savings/Cost (	3A x 3A1)			\$0	
B. Non Recurri	ng Savings (+)	or Cost (-)				
ltome	Savings(+)	Year of	Discount	Discounted Sav	<i>l-</i>	
lte <b>m</b>	Cost(-)(1)	Occur. (2)	Factor(3)	ings(+)Cost(-)(		
a.						
b.	-			<u></u>		
C.			*			
d. Total				**************************************		
C Total Non Er	nergy Discounte	ed Savings (3A2+3	3Bd4)	\$0		
4. Simple Payb	ack 1G/(2F3+3	3A+(3Bd1/Econom	nic Life)):	2.5	Years	
5. Total Net Dis	scounted Saving	gs (2F5+3C):		\$4,069		
	nvestment Ratio			5.57		
	ernal Rate of Re			16.62%		

### ECO C2: REPLACE PIPE INSULATION ON DOMESTIC HOT WATER SYSTEMS

Domestic hot water (DHW) system piping needing replacement insulation is listed by building on the attached tabular summary.

Thermal losses result from uninsulated piping. Energy savings are achieved when such pipes are insulated.

#### **Energy Saving Calculations**

For the purposes of analysis, DHW systems are divided into two types:

- 1. Non-Circulated DHW Systems
- 2. Circulated DHW Systems

#### Non-Circulated DHW Systems:

Non-circulating DHW systems are typically installed in residences and office type buildings. Hot water from the water heater or tank sits motionless in piping until a faucet or other valve is opened. Standing hot water looses heat to the ambient air over time as characterized by the following equation:

$$T = To + (Ti - To) e^{(-t/[Ct/Ut])}$$

#### where:

T = Temperature at time increment t

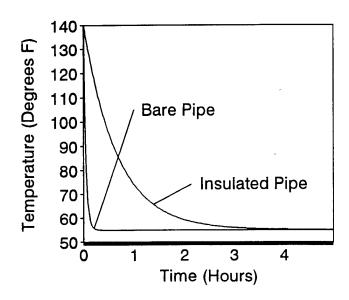
To = Ambient temperature, assumed to be 55 Degrees F

Ti = Initial temperature, taken to be the DHW heater set point temperature

t = Elapsed time

Ct = Heat capacity of water (1 BTU/Degree F)

Ut = Conductance of pipe and insulation (if any) (BTU/Hr-Degree F)



#### ECO C2: REPLACE PIPE INSULATION ON DOMESTIC HOT WATER SYSTEMS

#### Two questions arrise:

- 1. How long does it take the water in the piping to cool to an unacceptable level?
- 2. Does adding insulation effect this time significantly?

Review of the above plot and evaluation of the above equation for a bare pipe results in a time of about 6.6 minutes for water to cool from a temperature of 140 Degrees F to 90 Degrees F.

Review of the above plot and evaluation of the above equation for an insulated pipe results in a time of about 35 minutes for water to cool from a temperature of 140 Degrees F to 90 Degrees F.

Thus, if water demand is no more frequent than every 1/2 hour, insulation will not make a difference.

#### **Circulated DHW Systems:**

Hot water is circulated continuously through the piping system. Water temperature is maintained at or near the water heater set point. Heat transfer is steady state, unlike non-circulated systems.

Tabular calculations for circulated system heat losses follow this narrative.

Field investigation indicates that most pipes are insulated already, and that only a few repairs are required.

This ECO is evaluated assuming DEH has reset all water heater temperatures to authorized levels

#### Pipe Heat Loss (Gain) Calculations

The attached tabular calculations are performed as follows:

Size In-Dia.: Nominal pipe size, diameter in inches

Length LF: Pipe length needing insulation, linear feet

Energy savings are determined for each pipe size and service type by using nomographs developed by the U.S. Department of Energy (DOE) from their publication: "Energy Conservation in Existing Buildings", February 1980.

Use of the nomographs results in a heat loss rate of: BTUH per LF for "Bare" pipe and for insulated piping. For the purposes of these calculations, it is assumed that 1-inch of insulation is applied.

Bare Pipe: Heat loss for bare pipe determined from the DOE nomograph

Insulated Pipe: Heat loss for insulated pipe (1-inch thickness) determined from the

DOE nomograph

## ECO C2: REPLACE PIPE INSULATION ON DOMESTIC HOT WATER SYSTEMS

Boiler Efficiency: Domestic Hot \

Domestic Hot Water system boiler efficiency determined based on measurements of combustion efficiency and a field assessment of existing conditions. (Not displayed) Efficiency is applied to heat

loss rates to determine fuel use.

Savings:

Listed separately for Fuel Oil and for Propane; is the difference

between heat losses for bare and insulated piping.

#### **Energy Cost Savings**

Annual and life cycle energy cost savings are determined as follows:

**Annual Energy Cost Savings:** 

Propane

MBTU/Yr Saved x \$ 7.87/MBTU = \$/Yr Saved

Fuel Oil

MBTU/Yr Saved x  $4.98/MBTU = \frac{y}{r}$  Saved

Life Cycle Energy Cost Savings for economic life of 15 years:

Propane

\$/Yr Saved x (15 year UPW: 14.16) = LCC \$ Saved

Fuel Oil

\$/Yr Saved x (15 year UPW: 13.78) = LCC \$ Saved

#### **Construction Cost Estimate**

Bare costs are estimated based on "Means Construction Cost Estimating Guide 1993". Results are provided on the attached cost estimating forms.

Construction cost is determined by applying the following cumulative adders:

General Conditions:

8.0%

Estimating Contingency:

10.0%

Contractor's Overhead and Profit:

30.0% -

Bond:

1.0%

Investment is determined by adding the following separate factors of the construction cost:

Supervision, Inspection and (Government) Overhead (SIOH):

5.5%

Allowance for Design Services:

6.0%

#### **Economic Analysis**

Total Life Cycle Cost (LCC) Savings: Sum of energy and O&M LCC costs savings.

Simple Payback Period: Investment divided by the sum of annual energy and O&M cost savings.

Savings to Investment Ratio (SIR): Total LCC cost savings divided by the investment.

ECO C2 REPLACE PIPE INSULATION ON DOMESTIC HOT WATER SYSTEMS

Analysis of Circulated Domestic Hot Water Energy Savings

Yr         Mil BTU/Y         \$/Yr         \$/Yr         Savings           4         13.1         -         \$65         \$0         \$899           5         11.0         -         \$55         \$0         \$755           9         11.0         -         \$55         \$0         \$755           0         -         7.0         \$0         \$55         \$780           0         -         7.0         \$0         \$55         \$880           0         -         7.9         \$0         \$62         \$880           35.1         14.9         \$174.80         \$117.26         \$4,069	Fac	Bas	Baseline		Bare	Insulated	# CO3	ECO #2 Energy Savings	avings						
Tem         In Dia         LF         Mil BTU/Yr         Mil BTU/Yr         Mil BTU/Yr         Mil BTU/Yr         Mil BTU/Yr         Mil BTU/Yr         Sevings           105         2         10         55.5         42.4         13.1         -         \$65         \$0         \$899         8899           105         2         10         46.5         34.9         11.0         -         \$55         \$0         \$755         8755           105         1         10         45.9         34.9         11.0         -         \$55         \$0         \$755         8780           105         1         10         19.3         0.0         -         7.9         \$62         \$880         8760           105         1         10         14.2         0.0         -         7.9         \$62         \$800         87.0	No.	DHW	Size	Length	PipeL	Pipe Loss	Fuel Oil	Propane	Fuel Oil	Propane		Bare Cos	Bare Cos Investmen	Pay-	SIR
105         2         10         55.5         42.4         13.1         -         \$65         \$0         \$899         899           105         2         10         46.5         35.5         11.0         -         \$55         \$0         \$755         1           105         1         10         45.9         34.9         11.0         -         \$55         \$0         \$755         8780           105         1         10         19.3         0.0         -         7.9         \$62         \$880         870           105         1         10         14.2         0.0         -         7.9         \$17.480         \$117.26         \$4.069		Tem	In Dia	느	Mil BTU/Yr	Mil BTU/Yr	Mil BTU/Y	Mil BTU/Y		\$∕⊀		₩	↔	Back	
105         2         10         46.5         35.5         11.0         -         \$55         \$0         \$755           105         2         10         45.9         34.9         11.0         -         \$55         \$0         \$755         \$780           105         1         10         19.3         0.0         -         7.0         \$62         \$880         80           105         1         10         14.2         0.0         -         7.9         \$17.26         \$4.069	207	105	2	10	55.5	42.4	13.1		\$65	\$0	\$899	\$100	\$174	2.67   5.17	5.17
105         2         10         45.9         34.9         11.0         -         \$55         \$0         \$755           105         1         10         19.3         0.0         -         7.0         \$0         \$55         \$780           105         1         10         14.2         0.0         -         7.9         \$62         \$880           105         1         10         14.2         0.0         -         7.9         \$17.4.80         \$117.26         \$4.069	529	105	2	10	46.5	35.5	11.0		\$55	\$0	\$755	\$100	\$174	3.17 4.34	4.34
105         1         10         19.3         0.0         -         7.0         \$0         \$55         \$780           105         1         10         14.2         0.0         -         7.9         \$0         \$62         \$880           105         1         10         14.2         0.0         -         7.9         \$174.80         \$117.26         \$4,069         \$4	230	105	2	10	45.9	34.9	11.0	ı	\$55	\$0	\$755	\$100	\$174	3.17	4.34
105 1 10 14.2 0.0 - 7.9 \$0 \$62 \$880 Totals 35.1 14.9 \$174.80 \$117.26 \$4,069 \$	S 238	105	-	10	19.3	0.0	,	7.0	\$0	\$55	\$780	09\$	\$104	1.89 7	7.48
Totals 35.1 14.9 \$174.80 \$117.26 \$4,069	S 290	105	-	10	14.2	0.0		7.9	\$	\$62	\$880	09\$	\$104	1.68	8.44
						Totals	35.1	14.9	\$174.80	\$117.26	\$4,069	\$420	\$730	2.50 5.57	5.57

				Date Prepa	red	Sheet of		
CONSTRUCTION COST ESTIMATE					993			
Project				Project No.	Basis fo	r Estimate		
EEAP Limited Energy Study								
Location Code A (no design compet								
Fort Hunter-Liggett, California Engineer-Architect			-					
Keller & Gannon								
Drawing No.		Ëstimat			Checke	•		
ECO C2: Replace Pipe Insulation			RJB	Labor		BIH Material		
Line Item	No. Units	antity Unit Meas.	Per Unit	Total	Per Unit	Total	Total Cost	
Building 207								
2" Pipe Insulation	10	LF	\$6.00		60 \$4.00	\$40	\$100	
Subtotal Bldg 207							\$100	
				<u> </u>				
Building 229		1	T :	1	1			
2" Pipe Insulation	10	LF	\$6.00	9	60  \$4.00	\$40	\$100	
Subtotal Bldg 229	·	1	,				\$100	
			<u>L</u>					
Building 230	I	1	т	Τ				
2" Pipe Insulation	10	LF	\$6.00	] 9	60  \$4.00	\$40	\$100	
Subtotal Bldg 230		η	1	T			\$100	
			<u> </u>	J	<u> </u>			
Building 238		l. =	144.00	1	10 00 00		000	
1" Pipe Insulation	10	LF	\$4.00	1 4	\$40 \\$2.00	\$20	\$60	
Subtotal Bldg 238		1	1	T		<del></del>	\$60	
Building 000		<u> </u>		1	<u> </u>	1		
Building 290	10	ILF	\$4.00	1	640 \$2.00	\$20	\$60	
1" Pipe Insulation Subtotal Bldg 290	10	<u> </u>	ΤΨ4.00	<u> </u>	ο <del>το</del>  Ψ2.ος	γ ψ20	\$60	
Subtotal Blug 290		1	T	<u> </u>		1	400	
Subtotal		<del>                                     </del>	<del> </del>				\$420	
General Conditions @ 8%							\$34	
Subtotal		1					\$454	
Contractor OH & Profit @ 30%							\$136	
Subtotal			Ţ				\$590	
Bond @ 1%			1				\$6	
Subtotal			1				\$596	
Estimating Contingency @ 10%							\$60	
Total Probable Construction Cost							\$655	

ECO C-3

Location: Fort Hunter Liggett, California Project Title: ECIP Facility Energy Improvements Discrete Portion Name: ECO C3 Insulate Hot Water S				legion No. 4	*		Project No. Fiscal Year FY95	
Analysis Date: June 1993				conomic Life:	15	YEARS	Preparer: KELLER & GANNO	
1. Investment A. Constructi B. SIOH				\$4,578 \$252	<b>-</b>			
C. Design Co			-	\$275 \$5,105	<del>-</del> =			
D. Total Cost (1A+1B+1C)  E. Salvage Value of Existing Equipment  F. Public Utility Company Rebate				<b>45</b> ,132		\$0 \$0	_	
	stment (1D-1E-1F)						\$5,105	
2. Energy Sa	vings (+)/Cost(-):	d for Discount Factor	ro: Oct	obor 1002	_			
				unnual \$		Discount	Discounted	
Energy Source	Cost \$/MTBU/(1)	Saving MBTU/YR(2)		Savings(3)		Factor(4)	Savings(5)	
A. Elec. B. Dist C. Propane D. Demand	\$18.23 \$4.98 \$7.87 \$108.60	9.2 48.3 46.1 0.0	-  - kW	\$167.72 \$240.30 \$362.54 \$0.00		11.70 13.78 14.16 11.70	\$1,962 \$3,311 \$5,134 \$0	
E. Other F. Total			=	\$770.56	=		\$10,407	
3. Non Energ	y Savings (+) or	Cost (-):	-		_			
	curring (+/-) Factor (Table A) ed Savings/Cost (	3A x 3A1)	_	\$0	-	11.12	- \$0	
B. Non Recu	rring Savings (+)	or Cost (-)						
Item	Savings(+) Cost(-)(1)	Year of Occur. (2)		iscount actor(3)		Discounted Sav- ings(+)Cost(-)(4)		
a. b. c.			<b>-</b> -	-	_			
d. Total					-		•	
C Total Non	Energy Discounte	d Savings (3A2+3B	d4)			\$0		
5. Total Net [ 6. Savings to	yback 1G/(2F3+3 Discounted Saving Investment Ratio Internal Rate of Re	(SIR) 5/1G:	: Life)):			6.6 \$10,407 2.04 9.06%	Years	

### **ECO C3: INSULATE HOT WATER STORAGE TANKS**

Thermal losses result from uninsulated hot water storage tanks. Energy savings are achieved when the tanks are insulated.

Energy savings are determined for the domestic hot water tanks by using nomographs developed by the U.S. Department of Energy (DOE) from their publication: "Energy Conservation in Existing Buildings", February 1980. The attached table showing thermal losses for storage tanks is developed from the DOE nomograph.

Use of the charts results in heat loss rates for bare tanks and for tanks with various insulation thicknesses. For the purposes of these calculations, it is assumed that 3-inches of insulation is applied.

The attached tabular calculations are performed as follows:

#### Tank heat loss calculations

Tank Capacity:

Gallons

Existing Temp.:

degrees F

Ins. Thickness:

Existing thickness assumed to be 1-inch equivalent

Replacement insulation to be 3-inch

#### Heat Loss Rate BTU/Hr (from charts)

**Existing Condition:** 

Rate of heat loss or gain in BTUH for existing tank condition (1-inch thick insulation) determined from DOE nomograph

**Proposed Condition:** 

Rate of heat loss or gain in BTUH for tank with new insulation

(3-inch thick)determined from DOE nomograph

#### **Energy Savings Calculations**

Heat Loss:

The annual heat load loss for each condition is determined by multiplying the

heat loss rate per hour by 8,760 hours per year (continuous loss).

Annual Heat Loss Saved:

The annual heat loss load saved is the difference of the heat loss

for the exisiting and proposed conditions.

**Energy Savings:** 

Energy savings are determined by dividing the load savings by the DHW heater

efficiency. For DHW system efficiencies, refer to "EEAP Limited Energy Study,

Fort Hunter Liggett, California", 1993.

### **ECO C3: INSULATE HOT WATER STORAGE TANKS**

### **Energy Cost Savings**

Annual and life cycle energy cost savings are determined as follows:

Annual Energy Cost Savings:

Electricity

kWH/Yr Saved x 0.003413 MBTU/kWH x \$18.23/MBTU = \$/Yr Saved

Propane

MBTU/Yr Saved x \$ 7.87/MBTU = \$/Yr Saved

Fuel Oil

MBTU/Yr Saved x \$ 4.98/MBTU = \$/Yr Saved

Life Cycle Energy Cost Savings for economic life of 15 years:

Electricity

\$/Yr Saved x (15 year UPW: 11.70) = LCC \$ Saved

Propane

\$/Yr Saved x (15 year UPW: 14.16) = LCC \$ Saved

Fuel Oil

\$/Yr Saved x (15 year UPW: 13.78) = LCC \$ Saved

### **Construction Cost Estimate**

Bare costs are estimated based on "Means Construction Cost Estimating Guide 1993". Results are provided on the attached cost estimating forms.

Construction cost is determined by applying the following cumulative adders:

**General Conditions:** 

8.0%

Estimating Contingency:

10.0%

Contractor's Overhead and Profit:

30.0% -

Bond:

1.0%

Investment is determined by adding the following separate factors of the construction cost:

Supervision, Inspection and (Government) Overhead (SIOH):

Allowance for Design Services:

### **Operation and Maintenance Cost Savings**

Maintenance costs are expensed at 2.5% of the bare costs of installation p

5.5%

"Savings", entries are negative, or in parentheses.

6.0%

Life cycle maintenance cost savings are determined by multiplying the annual maintenance cost savings by the non-energy UPW factor of 11.12 (15 year economic life).

### **Economic Analysis**

Total Life Cycle Cost (LCC) Savings: Sum of energy and O&M LCC costs savings.

Simple Payback Period: Investment divided by the sum of annual energy and O&M cost savings.

Savings to Investment Ratio (SIR): Total LCC cost savings divided by the investment.

### ECO C3 INSULATE HOT WATER STORAGE TANKS

### Assumptions:

- 1. Existing Hot Water Heater tanks that do not have insulation blankets are assumed to have the equivalent of 1-inch thick insulation.
- 2. Installation of an insulation jacket will provide the equivalent of 3-inch thick insulation.
- 3. Heat losses are in addition to those included in "Efficiency" calulation under "Convection Losses".
- 4. Unless controlled by time clock or other means, losses are assumed to be continuous, 8,760 Hours per year.

### DOMESTIC HOT WATER TANK INSULATION

Building	DHW		Existing Cond	dition	Proposed Co	ndition	Heat Loss
Number	Tank	Existing	Tank Insttn	Heat Loss	Tank Insltn	Heat Loss	Load Saved
	Galions	Temp Deg F	Inches	Mil BTU/Yr	Inches	Mil BTU/Yr	Mil BTU/Yr
80	80	135	1	5.1	3	1.8	3.3
81	20 & 40	135	1	5.2	3	1.9	3.3
101	100	160	1	8.3	3	3.0	5.3
101	40	140	1	3.3	3	1.2	2.1
101	83	140	1	5.6	3	2.0	3.6
120	100	110	1	3.9	3	1.4	2.5
120	100	140	1	6.5	3	2.4	4.1
124	40	160	1	4.2	3	1.5	2.7
127	100	128	1	5.5	3	2.0	3.5
144	69	Not used	1	0.0	3	0.0	0.0
197	6	128	1	1.3	3	0.5	0.8
206	2 x 850	140	1	57.8	3	21.0	36.8
210	100	140	1	6.5	3	2.4	4.1
219	80	120	1	4.0	3	1.5	2.5
238	125	122	1	5.6	3	2.0	3.6
252	52	120	1	2.9	3	1.1	1.8
287	40	140	1	3.3	3	1.2	2.1
290	100	135	1	6.1	3	2.2	3.9

### DOMESTIC HOT WATER TANK INSULATION LOSSES:

Insulation Thickness	Tank	BTUH Losses at	Water Tempera	atures	The second secon				
(k = 0.3)	Gallons	100 Deg F	120 Deg F	122 Deg F	128 Deg F	135 Deg F	140 Deg F	160 Deg F	180 Deg F
(K = 0.0)	6	519	863	897	1,001	1,121	1,207	1,634	2,060
	20	768	1,277	1,327	1,480	1,658	1,785	2,407	3,028
	40	1,123	1,867	1,941	2,165	2,425	2,611	3,510	4,409
	50	1,301	2,163	2,249	2,507	2,809	3,024	4,062	5,100
	52	1,337	2,222	2,311	2,576	2,886	3,107	4,173	5,238
	69	1,639	2,724	2,833	3,158	3,538	3,809	5,111	6,413
Bare	80	1,834	3,049	3,170	3,534	3,959	4,263	5,718	7,172
	83	1,888	3,138	3,262	3,637	4,075	4,387	5,884	7,380
	100	2,190	3,640	3,784	4,219	4,727	5,089	6,822	8,554
	125	2,465	4,097	4,260	4,749	5,320	5,728	7,682	9,637
	250	3,840	6,382	6,636	7,398	8,288	8,923	11,987	15,051
	500	6,292	10,456	10,872	12,122	13,579	14,620	19,640	24,660
	850	9,725	16,160	16,804	18,735	20,987	22,596	30,354	38,113
	1,700	18,062	30,014	31,209	34,794	38,978	41,966	56,374	70,783
	6	83	129	134	147	164	175	223	270
	20	122	191	198	219	243	260	330	400
	40	178	280	290	320	356	381	483	585
	42	184	289	299	330	367	393	499	604
	50	206	324	335	371	412	441	560	678
	52	212	333	345	381	423	453	57 <b>5</b>	697
	69	259	408	422	467	519	556	705	854
1-inch Thick	80	290	456	473	522	581	622	789	956
1	82	296	465	482	533	592	634	805	975
	100	346	545	564	624	693	743	943	1,142
	125	390	613	635	702	780	836	1,061	1,285
	250	607	955	990	1,094	1,216	1,303	1,653	2,002
	500	994	1,565	1,622	1,793	1,992	2,135	2,708	3,280
	850	1,536	2,418	2,506	2,771	3,079	3,300	4,185	5,069
	1,700	2,852	4,490	4,654	5,146	5,719	6,129	7,772	9,414
	50	109	173	179	198	220	236	299	362
2-inch Thick	100	184	291	301	333	370	397	503	609
	250	323	510	528	584	649	696	883	1,069
	500	528	834	865	956	1,064	1,140	1,446	1,751
	6	29	46	48	53	59	63	81	98
	15	40	63	65	73	81	86	110	133
	20	43	69	71	79	88	94	120	145
	40	64	101	105	116	129	138	175	212
	42	66	104	108	119	133	142	180	218
	50	74	117	121	134	149	160	203	245
	52	76	120	124	138	153	164	208	252
	69	93	148	153	169	188	202	255	308
3-inch Thick	80	105	166	172	190	211	226	286	345
	83	108	171	177	196	217	233	294	355
	100	125	198	205	227	252	270	341	412
	125	141	222	230	255	283	304	384	464
	250	219	346	359	397	441	473	598	722
	500	359	567	588	650	723	775	980	1,184
	850	555	876	909	1,005	1,117	1,198	1,514	1,831
	1,075	681	1,075	1,115	1,233	1,370	1,470	1,857	2,247

Source: Architects and Engineers Guide to Energy Conservation in Existing Buildings, February 1980, U.S. DOE.

ECO-C3 INSULATE HOT WATER STORAGE TANKS

Fac	Existing	Existing Condition	ECO - C3	ECO - C3 Energy Savings	S								
ģ	Tank Insttn	Tank Insttn Heat Loss	Tank Insitn	Fuel Oil	Propane	Electric	FO Ann.	Prop. Ann Elec. Ann	Elec. Ann	သ	Bare	Invest-	SIR
	Inches	Mil BTU/Yr	Inches	Mil BTU/Yr	Mil BTU/Y	Mil BTU/Y	Savings	Savings	Savings	Savings	Cost	ment	
P 80	-	5.1	ဇ			3.3	0\$	0\$	09\$	\$204	\$75	\$130	5.40
P 81	-	5.2	3	,	,	3.3	0\$	0\$	09\$	\$704	\$150	\$261	2.70
P 101	-	8.3		•	9.2	•	0\$	09\$	0\$	\$844	\$100	\$174	4.85
	-	3.3	က	1	3.0	1	0\$	\$24	0\$	\$334	\$75	\$130	5.56
	-	5.6	က	•	5.1	ı	0\$	\$40	0\$	\$572	\$75	\$130	4.39
T 120	-	3.9	3	•	3.3	•	0\$	\$26	0\$	\$370	\$100	\$174	2.13
	-	6.5	3	•	5.8	1	0\$	\$46	0\$	\$652	\$100	\$174	3.75
T 127	-	5.5	က	•	5.0	a	\$0	\$39	0\$	\$556	\$100	\$174	3.20
S 197	-	1.3	က	•	-	0.8	0\$	0\$	\$15	\$171	\$75	\$130	1.31
P 206	-	57.8	3	42.4	-	•	\$211	\$0	0\$	\$2,909	\$1,560	\$2,713	1.07
P 210	-	6.5	ဧ	5.9	,		\$29	\$0	\$0	\$402	\$100	\$174	2.31
P 219	-	4.0	က	,	3.3	,	0\$	\$26	0\$	298\$	\$75	\$130	2.81
\$ 238	_	5.6	က	-	4.5	ı	0\$	\$35	0\$	\$200	\$100	\$114	2.87
P 252	•	. 2.9	က	·	1	1.8		\$0	\$33	\$384	\$75	\$130	2.94
P 287	_	3.3	ဗ	t	2.9		0\$	\$23	\$0	\$321	\$75	\$130	2.46
\$ 290	•	6.1	က	,	5.5	•	0\$	\$44	0\$	\$617	\$100	\$174	3.55
			Totals	48.3	46.1	9.2	240	363	168	\$10.407	\$2,935	\$5,105	2.04

CONSTRUCTION COST EST	IMAT	E		Date Prepared Sheet OF  June 1993			OF
Project				Project No.	Basis for	Estimate	
EEAP Limited Energy Study				Code A (no design competed)			
Location					Code A	(no design com	peted)
Fort Hunter-Liggett, California Engineer-Architect							
Keller & Gannon			•				
Drawing No.		Estimato	or		Checked	Ву	
ECO C3 Insulate Hot Water Storage Ta	ınks	RJB			він		
	Qu	antity		Labor	Per	Material	Total
Line Item	No. Units	Unit Meas.	Per Unit	Total	Unit	Total	Total Cost
< 80 Gal. DHW Heater Insulation Kit	9	Ea	\$48	\$432	\$27	\$243	\$675
fiberglas 1 1/2" thick							
> 80 Gal. DHW Heater	7	Ea	\$65	\$455	\$35	\$245	\$700
850 Gal. Tank Insulated w/3" CaSil	2	Ea	\$455	\$910	\$325	\$650	\$1,560
Subtotal				<u>.</u>			\$2,935
General Conditions @ 8%		<del>                                     </del>					\$235
Subtotal	<del>                                     </del>				ļ		\$3,170
	<del> </del>	<u> </u>			<del> </del>	1	\$951
Contractor OH & Profit @ 30%	<u> </u>				<u> </u>		\$4,121
Subtotal Subtotal	<del> </del>						\$41
Bond @ 1%	<del> </del>	ļ					\$4,162
Subtotal 2 10%	-	<del> </del>		<u> </u>	1		\$416
Estimating Contingency @ 10%	<del> </del>		•				
Total Probable Construction Cost							\$4,578
	<u> </u>						
	-				<u> </u>		
				1			
	+	-	<del> </del>		ļ		
	<del>                                     </del>	<del>                                     </del>			<del>                                     </del>		
	<del>                                     </del>	<del>                                     </del>	<del> </del>				
	1			1			
	<del>                                     </del>	†	-	1	1		

ECO C-5 TOTAL

Discrete Port	Fort Hunter Ligg ECIP Facility Ener ion Name: ECO CS e: June 1993		Hot V	Region No. 4 Vater Flow at Sho Economic Life:		Heads and Faucets	Project No. Fiscal Year FY95 B Preparer: KELLER & GANNON
E. Salvage V F. Public Util	on Costs		- - -	\$1,326 \$73 \$80 \$1,478	- - -	\$0 \$0	- - \$1,478
2. Energy Sa	vings (+)/Cost(-): IR 85-3273-X Used	for Discount Facto	rs: O	ctober 1992	_		
Energy Source	Cost \$/MTBU/(1)	Saving MBTU/YR(2)		Annual \$ . Savings(3)		Discount Factor(4)	Discounted Savings(5)
A. Elec. B. Dist C. Propane D. Demand	\$18.23 \$4.98 \$7.87 \$108.60	32.9 0.0 2.1 0.0	- - _ _ kW	\$599.77 \$0.00 \$16.86 \$0.00		11.70 13.78 14.16 11.70	\$7,017 \$0 \$239 \$0
E. Other F. Total	gy Savings (+) or 0	Cost (-):	=	\$616.63	=		\$7,256
A. Annual Re (1) Discount (2) Discount	ecurring (+/-) Factor (Table A) ed Savings/Cost (3	A x 3A1)	-	\$0	-	11.12	<b>\$0</b>
B. Non Recu	rring Savings (+) o Savings(+) Cost(-)(1)	or Cost (-) Year of Occur. (2)		Discount Factor(3)		Discounted Sav- ings(+)Cost(-)(4)	
a. b. c. d. Total			 - ·	• .	=		
C Total Non	Energy Discounted	d Savings (3A2+3B	d4)			\$0	
5. Total Net 6. Savings to	lyback 1G/(2F3+3/ Discounted Saving o Investment Ratio Internal Rate of Ret	(SIR) 5/1G:	: Life))	:		2.4 \$7,256 4.91 15.64%	Years

ECO C-5 PART A

Location: Project Title:	Fort Hunter Ligg ECIP Facility Ene	rgy Improvements		Region No. 4			Project No. Fiscal Year FY95
Discrete Porti	ion Name: ECO C	-5 PART A Install S	elf-Me	etering Faucets			
Analysis Date	e: June 1993			Economic Life:	15	YEARS	Preparer: KELLER & GANNON
1. Investment					_		
A. Constructi	on Costs			\$1,123	_		
B. SIOH				\$62	_		
C. Design Co	st		_	\$67	_		
D. Total Cost	(1A+1B+1C)		•	\$1,252	-		
E. Salvage Va	alue of Existing Ed	quipment				\$0	_
F. Public Utili	ty Company Reba	ate				\$0	_
G. Total Inves	stment (1D-1E-1F)	1					\$1,252
2 Energy Se	vings (+)/Cost(-):						
Date of NIST	R 85-3273-X Used	for Discount Factor	s: O	ctober 1992	-		
Energy	Cost	Saving		Annual \$		Discount	Discounted
Source	\$/MTBU/(1)	MBTU/YR(2)		Savings(3)		Factor(4)	Savings(5)
Source	ψ/W11 DO/(1)	(VIB10/111(E)		•		,	g-(-)
A. Elec.	\$18.23	20.1		\$366.42		11.70	\$4,287
B. Dist	\$4.98		-	\$0.00		13.78	\$0
C. Propane	\$7.87		-	\$0.00		14.16	\$0
D. Demand	\$108.60		kW	\$0.00		11.70	\$0
E. Other	<del>\$100.00</del>	<del></del>	= '``	40.00			•
F. Total			:	\$366.42	=		\$4,287
3. Non Energ	y Savings (+) or	Cost (-):			_		
A Annual Da	ourring (+/-)			\$0			
A. Annual Re	Factor (Table A)		•		-	11.12	
	ed Savings/Cost (	3A x 3A1)					\$0
. ,							•
B. Non Recu	rring Savings (+)	or Cost (-)					
item	Savings(+)	Year of		Discount		Discounted Sav-	
	Cost(-)(1)	Occur. (2)		Factor(3)		ings(+)Cost(-)(4)	
a.			_				
b.			-	-			_
C.					_		
d. Total				• .	-		•
C Total Non	Energy Discounte	d Savings (3A2+3Bo	14)			\$0	
4. Simple Pa	yback 1G/(2F3+3	A+(3Bd1/Economic	Life)	):		3.4	Years
	Discounted Saving		,,			\$4,287	
	Investment Ratio					3.42	
	nternal Rate of Re					12.89%	

ECO C-5 PART B

Location: Project Title:	Fort Hunter Ligg ECIP Facility Ene	rgy Improvements	Region No. 4			Project No. Fiscal Year FY95
Discrete Porti Analysis Date		-5 PART B Install F	Economic Life:	15	YEARS	Preparer: KELLER & GANNON
1. Investment	t Costs			_		
A. Constructi	on Costs		\$203	_		
B. SIOH			\$11			
C. Design Co	st		\$12	_		
•	(1A+1B+1C)		\$226			
	alue of Existing E	quipment			<b>\$0</b>	
	ty Company Reba				\$0	_
	stment (1D-1E-1F)					\$226
0 F==== So	vinas (+)/Cost(-):					
Date of NIST	vings (+)/Cost(-): IR 85-3273-X Used	d for Discount Factor	s: October 1992	<del></del>		
C	Cost	Saving	Annual \$		Discount	Discounted
Energy		MBTU/YR(2)	Savings(3)		Factor(4)	Savings(5)
Source	\$/MTBU/(1)	1010/111(2)	ouvings(o)		1 40.0.(1)	ouvg5(0)
A []aa	\$18.23	12.8	\$233.34		11.70	\$2,730
A. Elec. B. Dist	\$4.98		\$0.00		13.78	\$0
	\$7.87	2.1	- \$16.86		14.16	\$239
C. Propane D. Demand	\$108.60		kW \$0.00		11.70	\$0
E. Other	\$100.00					<b>4</b> -
F. Total			\$250.21	=		\$2,969
	y Savings (+) or	Cost (-):				
3. NOT LITERS	y cavings (1) or			_		
A. Annual Re	curring (+/-)		\$0			
	Factor (Table A)			_	11.12	
	ed Savings/Cost (	3A x 3A1)				<b>\$0</b>
B. Non Recu	rring Savings (+)	or Cost (-)				
	• • • • • • • • • • • • • • • • • • • •	.,				
ltem	Savings(+)	Year of	Discount		Discounted Sav-	
	Cost(-)(1)	Occur. (2)	Factor(3)		ings(+)Cost(-)(4)	
a.			_			
b.			- -			
c.						
d. Total			•	_		
C Total Non	Energy Discounte	ed Savings (3A2+3Bo	14)		\$0	
4. Simple Pa	yback 1G/(2F3+3	A+(3Bd1/Economic	Life)):		0.9	Years
	Discounted Saving		••		\$2,969	
	Investment Ratio				13.13	
7. Adjusted I	nternal Rate of Re	turn (AIRR):			23.48%	

## ECO C5: REDUCE DOMESTIC HOT WATER FLOW AT SHOWER HEADS AND FAUCETS

This ECO evaluates the reduction of hot water usage by the installation of metering or sensor operated lavatory faucets and/or low flow faucets and shower heads.

Energy savings are achieved by reducing domestic hot water (DHW) consumption.

This ECO is divided into two parts:

Part A Installation of Self-Metering faucets

Part B Installation of flow restricting shower heads and lavatory aspirators

### Part A

Hot water consumption can be reduced because self metering faucets prevent faucets from being left open, running continuously and wasting hot water.

Metering faucets allow water flow for only a few seconds, then the valve closes until the lever is depressed again.

Sensor operated lavatory faucets only permit water flow if a sensor perceives a person's hands inside the lavatory bowl.

Although catalog literature claims installation of said valves would reduce water consumption by 80%, it was more conservatively assumed to result in a 50% reduction in water consumption.

Thus the water savings was found by:

(# of people) x (4 hand washes per day) x (1 minute per hand wash) x 3 GPM x 50% = (# of people) x (6 gallons per day)

### Part B

Domestic hot water usage can also be reduced by the installation of flow restricting shower heads and lavatory faucets. Load reductions from existing shower heads and lavatory faucets are provided with Part B calculations.

### **Energy Savings Calculations**

Based on hot water supply temperature and gallons saved per day the energy savings were determined for both self-metering devices and flow restrictors (refer to EEAP Limited Energy Study for Fort Hunter Liggett, dated 1993). Load reductions are divided by the DHW heating system efficiency to calculate energy savings.

Annual and life cycle energy cost savings are determined as follows:

**Annual Energy Cost Savings:** 

Electricity kWH/Yr Saved x 0.003413 MBTU/kWH x \$18.23/MBTU = \$/Yr Saved

Propane MBTU/Yr Saved x \$ 7.87/MBTU = \$/Yr Saved Fuel Oil MBTU/Yr Saved x \$ 4.98/MBTU = \$/Yr Saved

# ECO C5: REDUCE DOMESTIC HOT WATER FLOW AT SHOWER HEADS AND FAUCETS

Life Cycle Energy Cost Savings for economic life of 15 years:

Fuel Oil \$/Yr Saved x (15 year UPW: 11.70) = LCC \$ Saved \$/Yr Saved x (15 year UPW: 14.16) = LCC \$ Saved \$/Yr Saved x (15 year UPW: 13.78) = LCC \$ Saved

### **Construction Cost Estimate**

Bare costs are estimated based on "Means Construction Cost Estimating Guide 1993". Results are provided on the attached cost estimating forms.

Construction cost is determined by applying the following cumulative adders:

General Conditions: 8.0% - 10.0% Estimating Contingency: 10.0% Contractor's Overhead and Profit: 30.0% Bond: 1.0%

Investment is determined by adding the following separate factors of the construction cost:

Supervision, Inspection and (Government) Overhead (SIOH): 5.5%
Allowance for Design Services: 6.0%

### Economic Analysis

Total Life Cycle Cost (LCC) Savings: Sum of energy and O&M LCC costs savings.

Simple Payback Period: Investment divided by the sum of annual energy and O&M cost savings.

Savings to Investment Ratio (SIR): Total LCC cost savings divided by the investment.

### **ECO C5 INSTALL FLOW RESTRICTORS**

### FLOW RESTRICTING SHOWER HEAD AND LAVATORY FAUCET RETROFIT

Non Lo-Flow Devices: Lo-Flow Devices:

Shower Heads 5.00 gpm 2.00 gpm Faucets 3.00 gpm 0.75 gpm

Function Code 1: Offices 2.00 GPCD

Assume use from faucets 75% and by Janitor 25%.

Usage with Lo-Flow faucet aspirators: 1.10 GPCD

Function Code 2: Shops & Warehouses 5.00 GPCD

Assume use from faucets 50% of total usage.

Usage with Lo-Flow faucet aspirators: 3.50 GPCD

Function Code 2.1: Commercial Laundries - Not Applicable to this ECO.

Function Code 3: Barracks & Quarters w/o Dining 30.00 GPCD

		Lo-Flow
Usage	GPCD	GPCD
Showers	19.50	7.80
Faucets	4.50	1.13
Clothes Washing	6.00	6.00
Total	30.00	14.93

Function Code 3.1: Detatched Latrine with Bathing 25.00 GPCD

		Lo-Flow
Usage	GPCD	GPCD
Showers	19.50	7.80
Faucets	4.50	1.13
Clothes Washing	0.00	0.00
Total	24.00	8.93

Function Code 4: Barracks & Quarters with Dining 30.00 GPCD

Same as Function Code 3 for non-cooking hot water usage:

14.93 GPCD

Function Code 5: Recreation & Gyms w/o Bathing 0.50 GPCD

Assume use from faucets 50% of total usage.

Usage with Lo-Flow faucet aspirators: 0.35 GPCD

Function Code 5.1: Recreation & Gyms with Bathing 12.00 GPCD

	-	
Usses	ODOD	Lo-Flow GPCD
Usage	GPCD	GPCD
Showers	10.50	4.20
Faucets	1.50	0.38
Clothes Washing	0.00	0.00
Total	12.00	4.58

### ECO C5 INSTALL FLOW RESTRICTORS

Function Code 6: Theaters & Sir	milar Commu	ınity Facilities		0.50
Assume use from faud Usage with Lo-Flow fa		_	0.35	GPCD
Function Code 7: Dining Facilities	es, all uses			0.25
Assume use from faugure with Lo-Flow fauge with Lo-Flow faugure faugur		_	0.18	GPCD
Function Code 8: Base Exchang	es & Stores		0.50	GPCD
Assume use from faud Usage with Lo-Flow fa		_	0.35	GPCD
Function Code 8.1: Commissarie	es		0.50	GPCD
Assume use from faud Usage with Lo-Flow fa		-	0.35	GPCD
Function Code 9: Clubs - Officer	s, NCO, Enli	sted Persons:		2.00
Assume use from faur Usage with Lo-Flow fa				GPCD
Function Code 10: Family Housi	ing		40.00	GPCD
Usage Showers Faucets Clothes Washing Total	GPCD 27.00 8.00 5.00 40.00	Lo-Flow GPCD 10.80 2.00 5.00 17.80		
Function Code 11.1: Schools wi	thout Bathin	g	5.00	GPCD
Usage Other Uses Faucets Total	GPCD 0.50 4.50 5.00	Lo-Flow GPCD 0.50 1.13 1.63		
Function Code 11.2: Schools wi	th Bathing		11.00	GPCD
Usage Showers Faucets Total	GPCD 6.50 4.50 11.00	Lo-Flow GPCD 2.60 1.13 3.73		

### ECO C5 INSTALL FLOW RESTRICTORS

Function Code 11.3: Child Development Centers

8.00 GPCD

		Lo-Flow
Usage	GPCD	GPCD
Showers	0.00	0.00
Faucets	8.00	2.00
Total	8.00	2.00

Function Code 12: Medical Facilities, Clinics

20.00 GPCD

No modifications are proposed for medical facilities.

Function Code 12.1: Medical Facilities, Hospitals

120.00 GPCD

No modifications are proposed for medical facilities.

Function Code 13: Buildings with More than One Use

Each type of use is considered separately.

ECO C5 PART A: INSTALLATION OF SELF-METERING FAUCETS

	SIR		4.14		4.14
	Invest-	ment	\$1,252		\$1,252
	Bare	Cost	\$720		\$720
l	၁၁၂	Savings	\$5,189		\$5,189
	Prop. An	Saving	,	-	,
	FO Ann.	Saving	-	-	•
	Elect. Ann	Savings	996\$		\$366
S	Propane   Elect. Ann   FO Ann.   Prop. An	Mil BTU/Y	•		ı
C5 Energy Savings	Fuel Oil	STU/Yr   Mil BTU/Y   Mil BTU/Y   Savings	•		
ECO CS Ene	Electric	Mil BTU/Yr	20.1		20.1
m	Capacity	Mii BTUH	1.875		
ng System	System	Temp.	132		
DHW Heati	Fuel	Used	Electric		
Fac	ġ		301		

ECO-C5 PART B: INSTALLATION OF FLOW RESTRICTING SHOWER HEADS AND LAVATORY FAUCETS

Analysis of the Effect of Installation of Flow Restricting Faucets/Shower Heads on Domestic Hot Water Energy Savings

Bldg.	DHW Heal	Heating System		ECO CS EI	ECO C5 Energy Savings								
Š	Fuel	System	Capacity	Electric	Fuel Oil	Propane	Propane   Elect. Ann Fuel Oil   Prop. Ann	Fuel Oil	Prop. Ann	<u>သ</u>	Bare	Invest-	SIR
	Osed	Temp.	ВТОН	Mil BTU/Y	BTU/Y Mil BTU/Yr	Mil BTU/Y	Mil BTU/Y \$ Savings   \$ Savings   \$ Savings	\$ Savings	\$ Savings	Savings	Cost	ment	
127	Propane	110	240,000			2.1	1	•	\$17	\$239	06\$	\$157	1.53
197	Electric	125	1.25 kW	12.8	,	,	\$233	•	-	\$2,730	\$40	\$20	39.24
				12.8		2.1	\$233		\$17	\$2,969	\$130		\$226 13.13

				Date Prepare		Sheet	OF
CONSTRUCTION COST E	ESTII	MATE	=	June 19	93		
Project				Project No.	Basis for E	stimate	
EEAP Limited Energy Study				<u> </u>	0-4-4/		-40
Location					Code A (I	no design comp	etea)
Fort Hunter-Liggett, California	<u> </u>			•	1		
Keller & Gannon							
Drawing No.		Estimat	tor		Checked B	у	
ECO-C5 Install Self-Metering Fauce		RJB			BIH		
Line Item	No.	Unit	Per	Labor	Per	aterial	Total
	Units	Meas.	Unit	Total	Unit	Total	Cost
Self-Metering Lav. Faucets	3	EA	\$40	\$120	\$200	\$600	\$720
	<u> </u>						
	<del> </del>						
Subtotal				ļ			\$720
General Conditions @ 8%					ļ		\$58
Subtotal	_				ļ		\$778
Contractor OH & Profit @ 30%						\$233	
Subtotal			•			\$1,011	
Bond @ 1%						\$10	
Subtotal			-			\$1,021	
Estimating Contingency @ 10%						\$102	
Total Probable Construction Cost						\$1,123	
				ļ			
					ł		
			•				
					T "		

CONOTENIOTION COST F	CTU	AAT	=	1	Date Prepared Sheet OF  June 1993				
CONSTRUCTION COST E	.5111	VIAT		l					
Project				Project No.	Basis for E	stimate			
EEAP Limited Energy Study				<u> </u>	Code A (	no design comp	(heted)		
Fort Hunter-Liggett, California		· <u> </u>			-	u u u u u u u u u u u u u u u u u	, otou)		
Engineer-Architect Keller & Gannon									
Drawing No.		Estima	tor		Checked B	у			
ECO-C5 Install flow restrictors		RJB			BIH				
Line Item	No.	uantity Unit	Per	Labor	Per Ma	aterial	Totai		
	Units	Meas.	Unit	Total	Unit	Total	Cost		
Bldg 127 Shower Flow Restrictors	3	LS	\$10	\$30	\$20	\$60	\$90		
Bldg 197 Lavatory Flow Restrictors	2	LS	\$15	\$30	\$5	\$10	\$40		
					ļ				
Subtotal							\$130		
General Conditions @ 8%							\$10		
Subtotal							\$140		
Contractor OH & Profit @ 30%							\$42		
Subtotal					\$ \$ \$				
Bond @ 1%									
Subtotal									
Estimating Contingency @ 10%	<u> </u>								
Total Probable Construction Cost									

ECO C8

Location: Project Title	Fort Hunter Ligg		Region No. 4			Project No. Fiscal Year FY95
Discrete Po	rtion Name: ECO C	08 Dishwasher Heat Re	covery			
	ite: June 1993		Economic Life:	15	YEARS	Preparer: KELLER & GANNO
1. Investme	nt Costs			_		
A. Construc	ction Costs		\$5,839	-		
B. SIOH			\$321	-		
C. Design C			\$350	=		
	st (1A+1B+1C)		\$6,510		**	
	Value of Existing E				\$0	<u> </u>
	ility Company Reb				\$0	
G. Total Inv	restment (1D-1E-1F	)				\$6,510
2. Energy S	Savings (+)/Cost(-):	:				
Date of NIS	TIR 85-3273-X Use	d for Discount Factor C	ctober 1992			
Energy	Cost	Saving	Annual \$		Discount	Discounted
Source	\$/MTBU/(1)	MBTU/YR(2)	Savings(3)		Factor(4)	Savings(5)
A. Elec.	\$21.84	0.0	\$0		11.70	\$0
B. Dist	\$4.98	339.0	\$1,688		13.78	\$23,263
C. Propane		0.0	<b>\$0</b>		14.16	<b>\$0</b>
D. Demand	\$108.60	0.0 k	w \$0		11.70	<b>\$0</b>
E. Other				=		
F. Total			\$1,688			\$23,263
3. Non Ene	rgy Savings (+) or	Cost (-):	·········	-		
Δ Annual F	Recurring (+/-)		(\$160)			
	t Factor (Table A)		(4.1.1.7)	-	11.12	
` '	ted Savings/Cost (	3A x 3A1)				(\$1,779)
B. Non Red	curring Savings (+)	or Cost (-)				
Item	Savings(+)	Year of	Discount		Discounted Sav-	
	Cost(-)(1)	Occur. (2)	Factor(3)		ings(+)Cost(-)(4)	
a.						_
b.			-			-
C.				=	HI	•
d. Total						
C Total No	n Energy Discounte	ed Savings (3A2+3Bd4)	•		(\$1,779)	
4. Simple F	ayback 1G/(2F3+3	BA+(3Bd1/Economic Li	fe)):		4.3	Years
	Discounted Saving			,	\$21,483	
6. Savings	to Investment Ratio	(SIR) 5/1G:			3.30	
_	Internal Rate of Re				12 62%	

### **ECO C8: DISHWASHER HEAT RECOVERY**

Install a commercial type package heat recovery unit at each dishwashing location in facility 206. The unit extracts waste heat from dishwasher discharge and it uses it to preheat cold water make-up.

The Waste Energy Transfer System, Molitor Industries, Inc. recycles 70% to 75% of water normally wasted.

### **Energy Saving Calculations**

Refer to attached brochure for supporting data. DHW to dishwashers is provided at 140 deg F from building system, fuel oil fired, average thermal efficiency 70.8%.

Of the total baseline DHW heating fuel use of 906 Mil BTU/yr in building 206, 50% is assumed used in the dishwasher. Dishwashers heat DHW from the DHW supply temperature to about 180 deg F for sanitizing; discharge temperature from the dishwasher is 180 deg F.

75% heat recovery is possible:

906 Mil. BTU/yr x 0.5 x 0.708 = 321 Mil. BTU/yr thermal load for dishwashing.

75% recovery = 321 Mil. BTU/yr x 0.75 = 240 Mil. BTU/yr recovery

Recovered heat is sent to the DHW makeup. Avoided use of fuel oil is:

(240 Mil. BTU/yr / 0.708) = 339 Mil. BTU/yr fuel oil saved

\$4.98 x 339 Mil. BTU/yr = \$1688/year saved

Annual Energy Cost Savings:

Fuel Oil

MBTU/Yr Saved x \$ 4.98/MBTU = \$/Yr Saved

Life Cycle Energy Cost Savings for economic life of 15 years:

Fuel Oil

\$/Yr Saved x (15 year UPW: 13.78) = LCC \$ Saved

### Operations and Maintenance (O&M) Costs

Allow 4 hrs/yr at \$40/hr for maintenance, cleaning, etc. = \$160/yr

Life cycle maintenance cost savings are determined by multiplying the annual maintenance cost savings by the non-energy UPW factor of 11.12 (15 year economic life).

### **Construction Cost Estimate**

Bare costs are estimated based on "Means Construction Cost Estimating Guide 1993". Results are provided on the attached cost estimating forms.

Construction cost is determined by applying the following cumulative adders:

General Conditions:

8.0%

Estimating Contingency:

10.0%

### **ECO C8: DISHWASHER HEAT RECOVERY**

Contractor's Overhead and Profit:

30.0%

Bond:

1.0%

Investment is determined by adding the following separate factors of the construction cost:

Supervision, Inspection and (Government) Overhead (SIOH):

5.5%

Allowance for Design Services:

6.0%

### **Economic Analysis**

Total Life Cycle Cost (LCC) Savings: Sum of energy and O&M LCC costs savings.

Simple Payback Period: Investment divided by the sum of annual energy and O&M cost savings.

Savings to Investment Ratio (SIR): Total LCC cost savings divided by the investment.

				Date Prepared		Sheet	OF
CONSTRUCTION COST ES	TIMAT	Έ		June 1993	3		
Project				Project No.	Basis for Est	imate	
EEAP Limited Energy Study							
Location			•		Code A (no	design compete	d)
Fort Hunter-Liggett, California							
Engineer-Architect							
Keller & Gannon		1			Checked By		
Drawing No.		Estimato	or		ВІН		
ECO-C8 Dishwasher Heat Recovery	- Qui	RJB antity	l s	abor	Mate	erial	
Line Item	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	Total Cost
Building 206							
Molitor or Equal Unit	1	Ea	\$352	\$352	\$1,217	\$1,217	\$1,569
Drain Piping 2-inch Galv	20	LF	\$8.99	\$180	\$6.78	\$136	\$315
Water Piping 1-inch CU	130	LF	\$6.14	\$798	\$3.52	\$457	\$1,256
Pipe Insulation 1-inch @ pipe	130	LF	\$2.52	\$328	\$1.47	\$191	\$519
Wiring	-	Job	\$100	\$100	\$50	\$50	\$150
Subtotal Building 206							\$3,808
General Conditions 8%						1	\$305
Contractor O.H. & P 30%							\$1,142
Sub Total							\$5,255
Bond 1%							\$53
Sub Total							\$5,308
Estimating Contingency 10%							\$531
Total Probable Construction Cost							\$5,839
	<b>-</b>						
	1						
	-		V				
	I	ll			l		

ECO C-9

		ergy improvements	Region No. 4 Flue Dampers on DHW	/ Systems	Project No. Fiscal Year FY95
	e: June 1993	oo maan Adomado	Economic Life:	15 YEARS	Preparer: KELLER & GANNON
1. Investmen	t Costs				
A. Constructi	on Costs		\$1,712		
B. SIOH			\$94		
C. Design Co	ost		\$103		
D. Total Cost	t (1A+1B+1C)		\$1,909		
E. Salvage V	alue of Existing E	quipment		\$0	
	ity Company Reba			\$0	
G. Total Inve	stment (1D-1E-1F)	)			\$1,909
2. Energy Sa	vings (+)/Cost(-):				
		d for Discount Factor	October 1992		
Energy	Cost	Saving	Annual \$	Discount	Discounted
Source	\$/MTBU/(1)	MBTU/YR(2)	Savings(3)	Factor(4)	Savings(5)
		, (,	3 ( )	( )	g-(-)
A. Elec.	\$21.84	0.0	\$0	11.70	\$0
B. Dist	\$4.98	51.0	\$254 -	13.78	\$3,500
C. Propane	\$7.87	31.0	\$244	14.16	\$3,455
D. Demand	\$108.60	0.0	kW \$0	11.70	\$0
E. Other					
F. Total			\$498		\$6,954
3. Non Energ	y Savings (+) or	Cost (-):			
A. Annual Re	curring (+/-)		\$0		
(1) Discount I	Factor (Table A)			11.12	
(2) Discounte	ed Savings/Cost (3	3A x 3A1)			\$0
B. Non Recur	ring Savings (+)	or Cost (-)			
Item	Savings(+)	Year of	Discount	Discounted Sav-	
	Cost(-)(1)	Occur. (2)	Factor(3)	ings(+)Cost(-)(4)	
a.					
b.			-		
C.					
d. Total					
C Total Non E	Energy Discounted	d Savings (3A2+3Bd	4) .	\$0	
		A+(3Bd1/Economic	_ife)):	3.8	Years
	iscounted Saving			\$6,954	
6. Savings to	Investment Ratio	(SIR) 5/1G:		3.64	
7. Adjusted In	nternal Rate of Ref	turn (AIRR):		13.36%	

### **ECO C9: INSTALL AUTOMATIC FLUE DAMPERS ON DHW SYSTEMS**

This measure is developed to evaluate the potential energy savings created by the installation of an automatic damper which closes off the flue whenever the burner has completed a firing cycle.

During normal operations, about 2% to 3% of boiler fuel use is lost through the flue between burner firing cycles.

### **Energy Savings Calculations**

Energy savings are achieved by raising the boiler/heater efficiency by about 1.5%. Fuel savings are determined based on baseline fuel use and existing boiler efficiencies. Baseline energy use and system efficiency determinations are provided in: "EEAP Limited Energy Study for Fort Hunter Liggett", dated 1993. Savings are calculated as follows:

 $Qs = Qo - Qo \times Efficiency / (Efficiency + 1.5%)$ 

where: Qs = Fuel Savings

Qo = Baseline fuel use (after reduction of domestic hot water

temperatures to authorized levels)

Efficiency = Baseline system efficiency

Annual energy cost savings are based on fuel savings calculations as explained above:

Propane MBTU/Yr Saved x \$ 7.87/MBTU = \$/Yr Saved Fuel Oil MBTU/Yr Saved x \$ 4.98/MBTU = \$/Yr Saved

Life Cycle Energy Cost Savings for economic life of 15 years:

Propane \$/Yr Saved x (15 year UPW: 14.16) = LCC \$ Saved Fuel Oil \$/Yr Saved x (15 year UPW: 13.78) = LCC \$ Saved

### **Construction Cost Estimate**

Bare costs are estimated based on "Means Construction Cost Estimating Guide 1993". Results are provided on the attached cost estimating forms.

Construction cost is determined by applying the following cumulative adders to bare costs:

General Conditions: 8.0%
Estimating Contingency: 10.0%
Contractor's Overhead and Profit: 30.0%
Bond: 1.0% -

Investment is determined by adding the following separate factors of the construction cost:

Supervision, Inspection and (Government) Overhead (SIOH): 5.5%
Allowance for Design Services: 6.0%

### **Economic Analysis**

Total Life Cycle Cost (LCC) Savings: Sum of energy and O&M LCC costs savings. Simple Payback Period: Investment divided by the sum of annual energy and O&M cost savings. Savings to Investment Ratio (SIR): Total LCC cost savings divided by the investment.

ECO C9 INSTALL AUTOMATIC FLUE DAMPERS ON DHW SYSTEMS

Fac		ECO	ECO CO	Energy Savings:	: Automatic	Automatic Flue Dampers	pers					
Š.	Installation Name	ဝှ	Fuel Oil	Propane	Electric	FO Ann.	FO Ann.   Prop. Ann. Elec. Ann.	Elec. Ann.		Constr	Invest-	SIR
		Incl.	Mil BTU/Yr	Mil BTU/Yr		\$ Savings	MW-Hr/Yr \$ Savings \$ Savings \$ Savings	\$ Savings	Savings	Cost	ment	
P 101	Open Din Cons (Haclenda)	Yes	_	2.59	-	0\$	\$20	0\$	687\$	\$268	\$633	0.46
P 128	Officers Quarters Military	Yes	-	15.78	•	0\$	\$124	0\$	\$1,759	\$568	\$633	2.78
P 210	P 210 Hith/Dntl Clinic w/ Beds	Yes	51.02	•	•	\$254	0\$	\$0	\$3,501	\$576	\$642	5.45
\$ 238	Sig Photo Lab	Yes	-	96'0	•	0\$	<b>2</b> \$	\$0	\$106	\$541	£09 <b>\$</b>	1.72
	Process	Yes	1	8.34	•	0\$	99\$	\$0	\$929			
P 295	P 295 Enl Barracks w/o Dining	Yes	-		-	0\$	\$120	\$0	\$1,695	\$268	\$633	2.68
Totals			51.0	31.0	0.0	\$254	\$244	0\$	\$6,955	\$1,712	\$1,909	3.64

CONSTRUCTION COST ES	— ΤΙΜΔΤ	F		Date Prepared June 1993	2	Sheet	OF
		<u> </u>					
Project				Project No.	Basis for	Estimate	
EEAP Limited Energy Study				<u> </u>	Code A	(no design comp	eted)
Fort Hunter-Liggett, California						, , , , , , , , , , , , , , , , , , , ,	,
Engineer-Architect					1		
Keller & Gannon		Y=					
Drawing No.		Estimato		•	Checked	- 2	
ECO-C9 Install Automatic Flue Damp		antity	RJB	abor		BIH Material	
Line Item	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	Total Cost
OIL FIRED HEATERS							
4-inch Diameter Auto-Damper	1	Ea	32.00	\$32	\$156	\$156	\$188
Relay & Wiring	-	Job	-	\$120	-	\$60	\$180
Subtotal 4-inch Flue, Oil Fired							\$368
General Conditions 8%							\$29
Contractor O.H. & P 30%							\$29
Sub Total							\$426
Bond 1%							\$4
Sub Total							\$431
Estimating Contingency 10%							\$43
Total Probable Construction Cost							\$474
6-inch Diameter Auto-Damper	1	Ea	34.90	\$35	\$161	\$161	\$196
Relay & Wiring	-	Job	-	\$120	-	\$60	\$180
Subtotal 6-inch Flue, Oil Fired							\$376
General Conditions 8%							\$30
Contractor O.H. & P 30%							\$113
Sub Total							\$519
Bond 1%							\$5
Sub Total				,_,			\$524
Estimating Contingency 10%							\$52
Total Probable Construction Cost							\$576
8-inch Diameter Auto-Damper	1	Ea	38.40	\$38	\$161	\$161	\$199
Relay & Wiring	-	Job	-	\$120	-	\$60	\$180
Subtotal 8-inch Flue, Oil Fired							\$379
General Conditions 8%							\$30
Contractor O.H. & P 30%				1.5.4.1.1.			\$114
Sub Total							\$524
Bond 1%					·,		\$5
Sub Total							\$529
Estimating Contingency 10%							\$53
Total Probable Construction Cost							\$582

			-	Date Prepared		Sheet	OF
CONSTRUCTION COST EST	IMAT	Έ		June 1993	3		
Project			· · · · · · · · · · · · · · · · · · ·	Project No.	Basis for	Estimate	
EEAP Limited Energy Study							
Location					Code A	(no design comp	peted)
Fort Hunter-Liggett, California					4		
Keller & Gannon							
Drawing No.		Estimato	or		Checked	Ву	
ECO-C9 Install Automatic Flue Damper	S		RJB		j	BIH	
Line Item	Qui No.	antity Unit	Le Per	abor	Per	Material	Total
LING ILONI	Units	Meas.	Unit	Total	Unit	Total	Cost
GAS FIRED HEATERS							_
4-inch Diameter Auto-Damper	1	Ea	32.00	\$32	\$134	\$134	\$166
Relay & Wiring	_	Job	-	\$120	-	\$60	\$180
Subtotal 4-inch Flue, Gas Fired							\$346
General Conditions 8%							\$28
Contractor O.H. & P 30%							\$104
Sub Total							\$478
Bond 1%							\$5
Sub Total							\$483
Estimating Contingency 10%							\$48
Total Probable Construction Cost					\$138 \$138 \$1 - \$60 \$1 \$3 \$1 \$1 \$2 \$2 \$3 \$4 \$5 \$5 \$5 \$5 \$5 \$5 \$5 \$5 \$5 \$5		\$531
6-inch Diameter Auto-Damper	1	Ea	34.90	\$35			\$173
Relay & Wiring	-	Job	-	\$120			\$180
Subtotal 6-inch Flue, Gas Fired							\$353
General Conditions 8%							\$28
Contractor O.H. & P 30%							\$106
Sub Total							\$487
Bond 1%							\$5
Sub Total							\$492
Estimating Contingency 10%							\$49
Total Probable Construction Cost							\$541
8-inch Diameter Auto-Damper	1	Ea	38.40	\$38	\$152	\$152	\$190
Relay & Wiring	-	Job	-	\$120	- \$60 \$1		\$180
Subtotal 8-inch Flue, Gas Fired					560 \$		\$370
General Conditions 8%			_		\$:		\$30
Contractor O.H. & P 30%						1	\$111
Sub Total							\$511
Bond 1%							\$5
Sub Total							\$516
Estimating Contingency 10%							\$52
Total Probable Construction Cost							\$568
		<u> </u>					

### **ECO D4 TOTAL**

	ECIP Facility Er	ggett, California nergy Improvem	ents			Project No Fiscal Yea	
Discrete Portion	Name: Replac	e Incandescent	Ligh	nting with Fluoresc			
Analysis Date:	June 1993			Economic Life: 1	5 YEARS	Preparer:	KELLER & GANNO
1. Investment C				\$37,630			
A. Construction	Costs			\$2,070			
B. SIOH C. Design Cost				\$2,258			
D. Total Cost (1				\$41,957			
E. Salvage Valu	•	winment		Ψ+1,001	\$0		
F. Public Utility					(\$4,645)		
G. Total Investr						;	\$37,312
<u>.</u> , , •	,						•
2. Energy Savin	ngs (+)/Cost(-):						
Date of NISTIR	85-3273-X Used	I for Discount Fa	actor	s: October 1992			
_				A	Di	D:-	
Energy	Cost	Saving		Annual \$	Discount		counted
Source	\$/MTBU/(1)	MBTU/YR(2)		Savings(3)	Factor(4)	Sav	vings(5)
A. Elec.	\$21.84	159.8		\$3,491	11.70	(	\$40,839
B. Dist	\$4.98	0.0		\$0	13.78	•	\$0
C. Propane	\$7.87	0.0		\$0	14.16		\$0
D. Demand	\$108.60	22.5	kW	\$2,439	11.70	•	\$28,542
E. Other							
F. Total				\$5,930			\$69,381
3. Non Energy	Savings (+) or (	Cost (-):					
A. Annual Recu				\$1,671	44.46		
(1) Discount Fa		VA O.A.4V			11.12	. ,	¢40 F70
(2) Discounted	Savings/Cost (3	3A X 3A1)				;	\$18,578
B. Non Recurrir	ng Savings (+)	or Cost (-)					
Item	Savings(+)	Year of		Discount	Discounted S	av.	
item	Cost(-)(1)	Occur. (2)		Factor(3)	ings(+)Cost(-		
	0031()(1)	000di. (2)		1 40.01(0)	111g5(17000t(	Λ.,	
a.							
b.		-		-		-	
C.						=	
d. Total				•	•		
C Total Non En	ergy Discounted	d Savings (3A2-	⊦3B¢	14)	\$18,578		
4. Simple Pavb	ack 1G/(2F3+3/	A+(3Bd1/Econd	mic	Life)):	4.9	Yea	ars
•	counted Saving	•		,,	\$87,960		
	vestment Ratio				2.36		
7. Adjusted Inte	ernal Rate of Ref	turn (AIRR):			10.12%	,	

### ECO D4 Part A

Location: Project Title:	ECIP Facility E	ggett, California nergy Improvem	ents	Region No. 4		Project N Fiscal Ye	ar FY95
Discrete Portion	n Name: Repla	ce Incandescent	Ligh	nting with Fluorescer			
Analysis Date:	June 1993			Economic Life: 15	YEARS	Preparer:	: KELLER & GANNON
1. Investment C	Costs						
A. Construction	n Costs			\$21,175			
B. SIOH				\$1,165			
C. Design Cost				\$1,270			
D. Total Cost (				\$23,610	\$0		
-	ue of Existing Ed				(\$2,715)		
	Company Reba ment (1D-1E-1F)				(ΨΖ,713)		\$20,895
G. Total livesu	nent (10-12-11)	)					420,000
2. Energy Savi	ngs (+)/Cost(-):						
			cto	rs: October 1992			
Energy	Cost	Saving		Annual \$	Discount	Dis	scounted
Source	\$/MTBU/(1)	MBTU/YR(2)		Savings(3)	Factor(4)	Sa	vings(5)
. =	<b>#04.04</b>	77.0		¢4 505	11.70		\$19,729
A. Elec.	\$21.84 \$4.98	77.2		\$1,686 \$0	13.78		\$0
B. Dist C. Propane	\$7.87	0.0		\$0	14.16	•	\$0
D. Demand	\$108.60		kW	\$8 <b>4</b> 5	11.70	-	\$9,889
E. Other	4100.00			<b>4</b>		•	,
F. Total				\$2,532		-	\$29,619
3. Non Energy	Savings (+) or	Cost (-):					
A. Annual Recu	urring (±/-)			\$894			
(1) Discount Fa				Ψ00-1	11.12		
` '	Savings/Cost (	3A x 3A1)				-	\$9,945
B. Non Recurri	ng Savings (+)	or Cost (-)					
là	Covings(1)	Year of		Discount	Discounted S	21/-	
Item	Savings(+) Cost(-)(1)	Occur. (2)		Factor(3)	ings(+)Cost(-		
	0031(-)(1)	000di. (2)		1 40.0.(0)	go( 1 ) 0 0 0 1 (	χ.,	
a.						-	
b.						_	
C.						=	
d. Total							
C Total Non Er	nergy Discounte	ed Savings (3A2+	+3B∈	d4)	\$9,945		
		A+(3Bd1/Econd	mic	: Life)):	6.1	Ye	ears
	scounted Saving				\$39,564		
_	nvestment Ratio				1.89		
7. Adjusted Int	ernal Rate of Re	eturn (AIRR):			8.52%	•	

### ECO D4 Part B

Location:		iggett, California	Region No. 4		roject No.
Project Title:		nergy Improvemer			iscal Year FY95
		ce Incandescent L	ighting with Fluoreso		
Analysis Date:	June 1993		Economic Life:	15 YEARS P	reparer: KELLER & GANNON
1. Investment (	Costs				
A. Construction			\$234		
B. SIOH			\$13		
C. Design Cost	t		\$14		
D. Total Cost (			\$261		
	ue of Existing E			\$0	
	Company Reb			(\$30)	
G. Total Invest	ment (1D-1E-1F	)			\$231
0. 5 0-14	(   ) (Coot( ):				
Date of NISTIR	ngs (+)/Cost(-): 85-3273-X Use	d for Discount Fac	tors: October 1992		
_	04	Carrian	Americal ¢	Discount	Discounted
Energy	Cost	Saving MBTU/YR(2)	Annual \$ Savings(3)	Factor(4)	Savings(5)
Source	\$/MTBU/(1)	MB10/11(2)	Gavings(G)	1 actor(+)	Odvings(0)
A. Elec.	\$21.84	0.7	\$16	11.70	\$181
B. Dist	\$4.98	0.0	\$0	13.78	\$0
C. Propane	\$7.87	0.0	\$0	14.16	\$0
D. Demand	\$108.60	0.1 k	N \$11	11.70	\$127
E. Other					
F. Total			\$26		\$308
3. Non Energy	Savings (+) or	Cost (-):			
A Annual Book	urring (+/-)		\$11		
A. Annual Rec	actor (Table A)		Ψ11	11,12	
	Savings/Cost (	3A x 3A1)			\$125
• •					
B. Non Recurri	ing Savings (+)	or Cost (-)			
ltem	Savings(+)	Year of	Discount	Discounted Sav	-
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	Cost(-)(1)	Occur. (2)	Factor(3)	ings(+)Cost(-)(4	4)
a.					
b.		-	•		
C.			-		
d. Total				<del></del>	
C Total Non E	nergy Discounte	ed Savings (3A2+3	Bd4)	\$125	
4. Simple Pavi	ack 1G/(2F3+3	3A+(3Bd1/Econom	nic Life)):	6.1	Years
	scounted Saving		**	\$433	
	nvestment Ratio			1.88	
	ernal Rate of Re			8.46%	

### ECO D4 Part C

Location: Project Title:	ECIP Facility E	ggett, California nergy Improvemer		F	Project No. Fiscal Year FY95
Discrete Portion Analysis Date:		ce incandescent L	ghting with Fluoreso Economic Life:	15 YEARS F	Preparer: KELLER & GANNON
F. Public Utility G. Total Investi	n Costs	ate )	\$2,808 \$154 \$168 \$3,131	\$0 (\$360)	 \$2,771
Date of NISTIR	85-3273-X Used	d for Discount Fac	tors: October 1992		
Energy Source	Cost \$/MTBU/(1)	Saving MBTU/YR(2)	Annual \$ Savings(3)	Discount Factor(4)	Discounted Savings(5)
A. Elec. B. Dist C. Propane D. Demand E. Other F. Total	\$21.84 \$4.98 \$7.87 \$108.60	16.1 0.0 0.0 1.8 kV	\$352 \$0 \$0 \$195 \$548	11.70 13.78 14.16 11.70	\$4,121 \$0 \$0 \$2,287
3. Non Energy	Savings (+) or	Cost (-):			
			\$212	11.12	\$2,359
Item	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Sa ings(+)Cost(-)	
a. b. c. d. Total					
C Total Non Er	nergy Discounte	ed Savings (3A2+3	Bd4)	\$2,359	
5. Total Net Dis 6. Savings to li	pack 1G/(2F3+3 scounted Saving nvestment Ratio emal Rate of Re	(SIR) 5/1G:	nic Life)):	3.6 \$8,767 3.16 12.30%	Years

### ECO D4 Part D

Location: Project Title:	ECIP Facility E	iggett, California nergy Improvement ca Incandescent Lic	Region No. 4 ts ghting with Fluoresc	F	roject No. iscal Year FY95 to 26W/8T4	
Analysis Date:		ce moandescent Lig	Economic Life: 1		reparer: KELLER & GANNO	Ν
1. Investment C A. Construction B. SIOH C. Design Cos	n Costs t		\$5,029 \$277 \$302 \$5,607			
F. Public Utility	ue of Existing E Company Reba	ate		\$0 (\$465)	<del></del> \$5,142	
2. Energy Savi	ngs (+)/Cost(-): 85-3273-X Use	d for Discount Factor	ors: October 1992			
Energy Source	Cost \$/MTBU/(1)	Saving MBTU/YR(2)	Annual \$ Savings(3)	Discount Factor(4)	Discounted Savings(5)	
A. Elec. B. Dist C. Propane D. Demand E. Other F. Total	\$21.84 \$4.98 \$7.87 \$108.60	24.9 0.0 0.0 3.5 kW	\$543 \$0 \$0 \$380	11.70 13.78 14.16 11.70	\$6,354 \$0 \$0 \$4,451	
	Savings (+) or	Cost (-):				
	urring (+/-) actor (Table A) l Savings/Cost (	3A x 3A1)	\$219	11.12	\$2,438	
B. Non Recurri	ing Savings (+) Savings(+) Cost(-)(1)	or Cost (-) Year of Occur. (2)	Discount Factor(3)	Discounted Sav		
a. b. c. d. Total			_			
C Total Non E	nergy Discounte	ed Savings (3A2+3	3d4)	\$2,438		
5. Total Net Di 6. Savings to I	back 1G/(2F3+3 scounted Saving nvestment Ratio ernal Rate of Re	(SIR) 5/1G:	ic Life)):	4.5 \$13,243 2.58 10.77%	Years	

### ECO D4 Part E

Location: Project Title:		iggett, California nergy Improven		Region No. 4		Project No Fiscal Yea		
Project Title.	n Name: Benia	co Incandescen	t Liał	nting with Fluoresce				
Analysis Date:		ce modificaci	t Ligi	Economic Life: 1			KELLER & GA	NON
1. Investment	Costs							
A. Constructio				\$3,900				
B. SIOH				\$214				
C. Design Cos	st .			\$234				
D. Total Cost				\$4,348				
	lue of Existing E	quipment		•	. \$0			
	y Company Reb				(\$500)			
	tment (1D-1E-1F						<b>\$3,848</b>	
2. Energy Sav Date of NISTIF	ings (+)/Cost(-): R 85-3273-X Use	: d for Discount F	acto	rs: October 1992				
Energy	Cost	Saving		Annual \$	Discount	Dis	counted	
Source	\$/MTBU/(1)	MBTU/YR(2)		Savings(3)	Factor(4)	Sav	vings(5)	
					11.70		¢6 957	
A. Elec.	\$21.84	26.8	-	\$586	11.70		\$6,857 \$0	
B. Dist	\$4.98	0.0	-	\$0 \$0	13.78		\$0 \$0	
C. Propane	\$7.87	0.0		\$0	14.16			
D. Demand	\$108.60	3.8	<sub>_</sub> kW	\$411	11.70		\$4,803	
E. Other							111 000	
F. Total				\$997		;	\$11,660	
3. Non Energy	/ Savings (+) or	Cost (-):						
A. Annual Rec	curring (+/-)			\$208				
	actor (Table A)				11.12			
	d Savings/Cost (	(3A x 3A1)					\$2,316	
B. Non Recur	ring Savings (+)	or Cost (-)						
Item	Savings(+)	Year of		Discount	Discounted Sa	V-		
nom	Cost(-)(1)	Occur. (2)		Factor(3)	ings(+)Cost(-)	(4)		
a.								
b.			-					
C.								
d. Total			=					
C Total Non E	nergy Discounte	ed Savings (3A2	+3B	d4)	\$2,316			
4. Simple Pav	back 1G/(2F3+3	3A+(3Bd1/Econ	omic	: Life)):	3.2	Ye	ars	
	iscounted Savin			,,	\$13,976			
	Investment Ratio				3.63			
	tornal Bate of Be				13.34%			

### ECO D4 Part F

	ECIP Facility E	ggett, California nergy Improvements ce Incandescent Lig		F	roject No. iscal Year FY95 to 2-F32/T8	
Analysis Date:		se meandescent Lig	Economic Life:	15 YEARS P	reparer: KELLER & GAN	NON
1. Investment C A. Construction B. SIOH C. Design Cost D. Total Cost (1 E. Salvage Valu F. Public Utility G. Total Investr	A+1B+1C) le of Existing Ed Company Reba	ate	\$4,485 \$247 \$269 \$5,000	\$0 (\$575)	 \$4,425	
2. Energy Savir	ngs (+)/Cost(-):	for Discount Facto	m: October 1002			
Date of NISTIR	85-3273-X Used	i for Discount Facto	rs. October 1992			
Energy Source	Cost \$/MTBU/(1)	Saving MBTU/YR(2)	Annual \$ Savings(3)	Discount Factor(4)	Discounted Savings(5)	
A. Elec. B. Dist C. Propane D. Demand E. Other F. Total	\$21.84 \$4.98 \$7.87 \$108.60	14.1 0.0 0.0 5.5 kW	\$307 \$0 \$0 \$597	11.70 13.78 14.16 11.70	\$3,596 \$0 \$0 \$6,985	
3. Non Energy	Savings (+) or	Cost (-):				
A. Annual Recu (1) Discount Fa (2) Discounted	ctor (Table A)	3A x 3A1)	<u> </u>	11.12	\$1,395	
B. Non Recurring	ng Savings (+)	or Cost (-)				
ltem	Savings(+) Cost(-)(1)	Year of Occur. (2)	Discount Factor(3)	Discounted Savings(+)Cost(-)(		
a. b. c. d. Total			-			
	eray Discounte	d Savings (3A2+3B	d4)	\$1,395		
4. Simple Payb 5. Total Net Dis 6. Savings to Ir		A+(3Bd1/Economic gs (2F5+3C): (SIR) 5/1G:		4.3 \$11,976 2.71 11.14%	Years	

### **ECO D4: REPLACE INCANDESCENT LIGTHTING WITH FLUORESCENT**

This project would replace inefficient incandescent fixtures with efficient compact fluorescent fixtures or four-foot fixtures with electronic ballasts and T8 lamps. Replacements analyzed are shown in the table on the following page.

The proposed retrofits are described as follows:

Retrofits

Replace existing 60-100W surface-mounted incandescent lamps with

A, B & C

13W/5T4 to 18W/8T4 compact fluorescent lamps.

Retrofit D

Retrofit existing recessed incandescent downlight (150W lamp) with fluorescent ballast and socket adapter for 26W/8T4 quad lamp.

Retrofits E & F Replace existing suspended incandescent fixture (250-300W lamps) with industrial pendant-mounted fluorescent fixture containing 2-F32/T8 lamps

and electronic ballast.

Additional assumptions are as follows:

- 1. Hours of lamp operation based on field survey data.
- 2. Annual usage savings = (No. Fixtures) x (kW savings per fixture) x (operating Hrs./Year)
- 3. Annual Usage Cost Savings = kWh x \$0.07454 (Year-round, daytime average rate)
- 4. Annual O & M Cost =
  (Operating Hrs./Year) x [(Relamp Cost Exist / Mean Life Exist) (Relamp Cost Retrofit/Mean Life Retrofit)]
- 5. LCC Savings = Annual O&M Cost Savings x 11.12 +

Annual kWh Cost Savings x 11.70 + Annual kW Cost Savings x 11.70

Where Annual kW Cost Savings = kW Savings x \$108.60

6. Construction Cost Estimate

Bare costs are estimated based on "Means Construction Cost Estimating Guide 1993". Results are provided on the attached cost estimating forms.

Construction cost is determined by applying the following cumulative adders:

General Conditions:

8.0%

Estimating Contingency:

10.0%

Contractor's Overhead and Profit:

30.0%

Bond:

1.0%

Total Cost is determined by adding the following separate factors of the construction cost:

Supervision, Inspection and (Government) Overhead (SIOH):

5.5%

Allowance for Design Services:

6.0%

Investment is the Total Cost less the PG&E Rebate for the retrofit.

# ECO D4 REPLACE INCANDESCENT LIGHTING WITH FLUORESCENT

# Data and Assumptions

Mean         Relamping         Retrofit         Total         Mean         Relamping         Demand Labor         Matrl         Total         PG&E           1. Life 1         Cost         Lamp         Life 2         Cost         Cost         Cost         Cost         Cost         Rebate           1. Cost         (#ours)         (#w)         (#)	Existing Incandescent Lamps	descent	Lamps		Replacem	ent Fluc	Replacement Fluorescent Lamps		Economic Screening Analysis	Scree	ing Ana	ılysis			
Lamp         Life 1         Cost         Cost         Cost         Cost         Cost         Cost         Cost         Cost         Cost         Rebate           Watts         (Hours)         (\$)	Retrofit	Total	Mean	Relamping	Retrofit	Total	Mean	Relamping	Demand	Labor	Matri	Total	PG&E	Total	Breakeven
(Hours) (\$) (\$) (\$) (\$) (\$) (\$) (\$) (\$) (\$) (\$	Designation	Lamp		Cost	Lamp	Lamp	Life 2	Cost		Cost	Cost	Cost		Invest-	Invest- Operating
1,000         1.50 + 1.50 Labor         13W/574         17         10,000         10.00 + 3.00 Labor         0.043         \$35         \$40         \$130           750         1.50 + 1.50 Labor         18W/774         25         10,000         10.00 + 3.00 Labor         0.05         \$35         \$40         \$130           750         2.00 + 1.50 Labor         26W/874         25         10,000         10.00 + 3.00 Labor         0.075         \$35         \$40         \$130           750         2.40 + 1.50 Labor         26W/874         37         10,000         15.00 + 3.00 Labor         0.113         \$44         \$60         \$181           750         2.75 + 1.50 Labor         2-732/78         61         20,000         8.00 + 5.20 Labor         0.189         \$50         \$75         \$217           750         4.45 + 1.50 Labor         2-732/78         61         20,000         8.00 + 5.20 Labor         0.239         \$50         \$75         \$217		Watts		(\$)	Type	Watts	(Hours)	(\$)	(kW)	(\$)	(\$)	(\$)	(\$)	ment (\$)	ment (\$) Hrs/Year
750         1.50 + 1.50 Labor         18W/7T4         25         10,000         10.00 + 3.00 Labor         0.05         \$35         \$40         \$130           750         2.00 + 1.50 Labor         18W/7T4         25         10,000         10.00 + 3.00 Labor         0.075         \$35         \$40         \$130           750         2.40 + 1.50 Labor         26W/8T4         37         10,000         15.00 + 3.00 Labor         0.113         \$44         \$60         \$181           750         2.75 + 1.50 Labor         2-F32/T8         61         20,000         8.00 + 5.20 Labor         0.189         \$50         \$75         \$217           750         4.45 + 1.50 Labor         2-F32/T8         61         20,000         8.00 + 5.20 Labor         0.239         \$50         \$75         \$217	A	8	1,000	1.50 + 1.50 Labor	13W/5T4	17		10.00 + 3.00 Labor		\$35	\$40	\$130	\$15	\$115	1,070
750 2.00 + 1.50 Labor 18W/774 25 10,000 10.00 + 3.00 Labor 0.075 \$35 \$40 \$130 750 2.40 + 1.50 Labor 26W/874 37 10,000 15.00 + 3.00 Labor 0.113 \$44 \$60 \$181 750 2.75 + 1.50 Labor 2-F32/78 61 20,000 8.00 + 5.20 Labor 0.189 \$50 \$75 \$217 750 4.45 + 1.50 Labor 12-F32/78 61 20.000 8.00 + 5.20 Labor 0.239 \$50 \$75 \$217	В	75	750	1.50 + 1.50 Labor	18W/7T4	25		10.00 + 3.00 Labor	0.05	\$35	\$40	\$130	\$15	\$115	825
750         2.40 + 1.50 Labor         26W/8T4         37         10,000         15.00 + 3.00 Labor         0.113         \$44         \$60         \$181           750         2.75 + 1.50 Labor         2-F32/T8         61         20,000         8.00 + 5.20 Labor         0.189         \$50         \$75         \$217           750         4.45 + 1.50 Labor         2-F32/T8         61         20.000         8.00 + 5.20 Labor         0.239         \$50         \$75         \$217	O	100	750		18W/7T4	52		10.00 + 3.00 Labor		\$35	\$40	\$130	\$15	\$115	190
750 2.75 + 1.50 Labor 2-F32/T8 61 20,000 8.00 + 5.20 Labor 0.189 \$50 \$75 \$217	۵	150	750	2.40 + 1.50 Labor	26W/8T4	37	10,000	15.00 + 3.00 Labor		\$44	09\$	\$181	\$15	\$166	220
750 445 + 150 labor 12-F32/78 61 20 000 8 00 + 5.20 Labor 0.239 \$50 \$75 \$217	ш	250		2.75 + 1.50 Labor	2-F32/T8	61	20,000	8.00 + 5.20 Labor	0.189	\$50	\$75	\$217	\$25	\$192	0
	u.	300	750	4.45 + 1.50 Labor	2-F32/T8	61	20,000	8.00 + 5.20 Labor	0.239	\$20	\$75	\$217	\$25	\$192	0

1. Total Cost = (Labor + Material) x 1.08 x 1.30 x 1.01 x 1.10 x 1.115

2. Breakeven Operating = Hours per Year

Total Investment - (kW Savings x \$108.60 x 11.70)
(kW Savings x \$0.07454 x 11.70) + [(Relamp \$ / Mean Life 1 - Relamp \$ / Mean Life 2) x 11.12]

Total Investment = Total Cost - PG&E Rebate

Beakeven operating hours per year represent the minimum required operating hours per year for the proposed retrofits to be economically justified. 4.

SUMMARY OF ECO D-4: REPLACE INCANDESCENT LIGHTING WITH FLUORESCENT

ECO	SUMM	ARY OF EC	SUMMARY OF ECO D4 ANALYSES	SES								
No.	ш	<b>Energy Savings</b>	ings			O&M	LCC Savings Construction	onstruction	Total Cost	Rebate	Investment	SIR
	Fxtrs	kWH/Yr	kWH/Yr kW Demand Use	Use \$/Yr	Demand \$/Yr	\$/Yr	<del>69</del>	₩.	မ	₩	€9	
A: 60W Savings	181	22,623	7.8	\$1,686	\$845	\$894	0,	\$21,175	\$23,610	\$2,715	\$20,895	1.89
B: 75W Savings	0	208	0.1	\$16	\$11	\$11		\$234	\$261	\$30	\$231	1.88
C: 100W Savings	24	4,725	4.8	\$352	\$195	\$212		\$2,808	\$3,131	\$360	\$2,771	3.16
D: 150W Savings	3	7,286	3.5	\$543	\$380	\$219	0,	\$5,029	\$5,607	\$465	\$5,142	2.58
E: 250W Savings	8	7,862	3.8	\$586	\$411	\$208	•,	\$3,900	\$4,348	\$500	\$3,848	3.63
F: 300W Savings	23	4,124	5.5	\$307	\$597	\$125	\$11,976	\$4,485	\$5,000	\$575	\$4,425	2.71
TOTALS	281	46,828	22.5	\$3,491	\$2,439	\$1,671		\$37,630	\$41,957	\$4,645	\$37,312	2.36

ECO D-4 REPLACE INCANDESCENT LIGHTING WITH FLUORESCENT: SUMMARY OF TOTAL PROJECT PER BUILDING

Energy Savings         Energy	Fac	SIR > 1.0 D4A	3,	SIR > 1.0 D4B	S	SIR > 1.0 D4C	o,	SIR > 1.0 D4D	တ	SIR > 1.0 D4E	111	SIR > 1.0 D4F	.0 D4F	SIR >	SIR > 1.0 D4 All	
1,803 0.4	Š.	Energy Savings kWH/Y kW Den	nand	Energy Savings kWH/Y kW Dema	ਰ	ergy Savings VH/Y kW Dem	and k	inergy Savings WH/Y kW Dema	г Шх	nergy Savin WH/Y kW D	gs emand	Energy kWH/Y	Savings kW Deman	Energ d kWH/	Energy Savings kWH/Yr kW Demand	and
1,803       0.4       -       -       349       0.1       -       -       9,341         250       0.1       -       2,182       0.1       -       -       -       9,341         2,892       0.9       -       -       2,123       1.0       -       -       -       -       -         6,887       2.2       -       -       3,123       1.0       -<	P 80		١.	-	Ι.	86	0.2								86	0.2
1,803         0.4         -         349         0.1         -         9,341           2,892         0.9         -         3,123         1.0         -         -         9,341           80         0.9         -         3,123         1.0         -         -         -         -           1,046         0.6         -<	P 81	•	٠			•				•	٠	783	4.8		783	<b>4</b> .8
250         0.1         -         218         0.1         -	T 120	1,803	0.4	•			0.1	•			•	3,341	0.7	5,493	8	4.
2,892       0.9       -       3,123       1.0       -       <	T 121	250	0.1	,			0.1			•	•	•	•	4	469	0.2
6,887 2.2 -	T 127	2,892	6.0	•	ო •		0.	,		•	•	•	•	- 6,016	16	<u>6</u> .
400       0.00       - <td>P 128</td> <td></td> <td>2.2</td> <td></td> <td></td> <td>•</td> <td>•</td> <td>•</td> <td></td> <td>•</td> <td>•</td> <td>•</td> <td>•</td> <td>- 6,887</td> <td>87</td> <td>2.2</td>	P 128		2.2			•	•	•		•	•	•	•	- 6,887	87	2.2
1,046       0.6       - </td <td>T 156</td> <td></td> <td>0.0</td> <td></td> <td>,</td> <td>ı</td> <td></td> <td>•</td> <td></td> <td>•</td> <td>•</td> <td>•</td> <td>•</td> <td></td> <td>80</td> <td>0.0</td>	T 156		0.0		,	ı		•		•	•	•	•		80	0.0
429       0.1       - <td>S 197</td> <td></td> <td>9.0</td> <td></td> <td>•</td> <td>1</td> <td></td> <td>•</td> <td></td> <td>•</td> <td>•</td> <td>•</td> <td>•</td> <td>- 1,0</td> <td>1,046</td> <td>9.0</td>	S 197		9.0		•	1		•		•	•	•	•	- 1,0	1,046	9.0
413       0.1       - <td>P 205</td> <td>429</td> <td>0.1</td> <td>•</td> <td></td> <td>•</td> <td></td> <td>,</td> <td></td> <td></td> <td>•</td> <td>1</td> <td>·</td> <td>4</td> <td>429</td> <td>0.1</td>	P 205	429	0.1	•		•		,			•	1	·	4	429	0.1
413       0.1       - <td>P 207</td> <td>413</td> <td>0.1</td> <td>,</td> <td></td> <td>•</td> <td>•</td> <td>•</td> <td></td> <td></td> <td>•</td> <td>•</td> <td></td> <td>4</td> <td>413</td> <td>0.7</td>	P 207	413	0.1	,		•	•	•			•	•		4	413	0.7
1,831       1.7       - </td <td>P 208</td> <td>413</td> <td>0.1</td> <td>ı</td> <td></td> <td>•</td> <td></td> <td>1</td> <td></td> <td>ı</td> <td>•</td> <td>į</td> <td></td> <td>4</td> <td>413</td> <td>0.1</td>	P 208	413	0.1	ı		•		1		ı	•	į		4	413	0.1
413       0.1       - <td>P 209</td> <td>1,831</td> <td>1.7</td> <td>•</td> <td></td> <td>•</td> <td></td> <td>•</td> <td></td> <td>•</td> <td>•</td> <td>•</td> <td>•</td> <td>1,831</td> <td>31</td> <td>1.7</td>	P 209	1,831	1.7	•		•		•		•	•	•	•	1,831	31	1.7
413       0.1       - <td>P 229</td> <td>413</td> <td>0.1</td> <td>•</td> <td></td> <td>•</td> <td>•</td> <td>•</td> <td></td> <td>•</td> <td>•</td> <td>•</td> <td></td> <td>4</td> <td>413</td> <td>0.7</td>	P 229	413	0.1	•		•	•	•		•	•	•		4	413	0.7
89       0.0       -	P 230	413	0.1	,		•	1	,			•	•	•	4	413	0.
89         0.0         -         -         -         -         3,538         1.7         -           -         -         208         0.1         -         -         393         0.2         -           89         0.0         -         -         -         3,931         1.9         -           161         0.1         -         936         0.5         -         -         -         -           5,409         1.2         -         -         -         -         -         -         -         -           22,623         7.8         208         0.1         4,725         1.8         7,286         3.5         7,862         3.8         4,124	S 238	•				•			5.5		•	•		- 7,286	98	3.5
208       0.1       -       -       393       0.2       -         89       0.0       -       -       -       -       3,931       1.9       -         -       -       -       -       -       -       -       -       -         -       -       -       -       -       -       -       -       -         5,409       1.2       -       -       -       -       -       -       -         22,623       7.8       208       0.1       4,725       1.8       7,286       3.5       7,862       3.8       4,124	P 252	88	0.0		,				•	3,538	1.7	•		- 3,628	28	1.7
89         0.0         -         -         -         3,931         1.9         -           -         -         -         936         0.5         -         -         -         -           161         0.1         -         -         -         -         -         -         -           5,409         1.2         -         -         -         -         -         -         -           22,623         7.8         208         0.1         4,725         1.8         7,286         3.5         7,862         3.8         4,124	P 256	•	•		<del>-</del> .	,		,		393	0.2	•		9	601	0.3
161     0.1     -     -     936     0.5     -	P 259	68	0.0	•	,	•	•	1		3,931	1.9	•		- 4,021	21	6.
161     0.1     -	S 283	•	•	1	,		0.5	1	•	1	•	•		6	936	0.5
5,409     1.2     - <t< td=""><td>S 291</td><td>161</td><td>0.1</td><td>•</td><td></td><td>•</td><td>•</td><td></td><td></td><td>ı</td><td>•</td><td>•</td><td></td><td></td><td>161</td><td>9.</td></t<>	S 291	161	0.1	•		•	•			ı	•	•			161	9.
22,623 7.8 208 0.1 4,725 1.8 7,286 3.5 7,862 3.8 4,124	P 295	5,409	<u>5</u>	•		•	•	-	,	•	-	-		- 5,409	60	1.2
	TOTALS	22,623	7.8							7,862	3.8	4,124	5.5	5 46,828		22.5

ECO D-4 REPLACE INCANDESCENT LIGHTING WITH FLUORESCENT

Fac	A: 60	W to 13W/	A: 60 W to 13W/5T4 Savings									
o N	_	Energy Savings	vings			0&M		LCC Savings Construction	Total Cost	Rebate	Investment	SIR
	Fxtrs	kWH/Yr	kWH/Yr kW Demand	Use \$/Yr	Demand \$/Yr	\$/Yr	₩	₩	₩	\$	₩	
T 120	6	1,803	4.0	\$134	\$42	\$71.29	\$2,857	\$1,053	\$1,174	\$135	\$1,039	2.75
T 121	8	250	0.1	\$19	\$6	\$9.90	\$438	\$234	\$261	\$30	\$231	1.90
T 127	2	2,892	6.0	\$216	\$98	\$114.35	\$4,942	\$2,457	\$2,739	\$315	\$2,424	2.04 40
P 128	20	6,887	2.2	\$513		\$272.27	•	\$5,849	\$6,522	\$750	\$5,772	2.04
T 156	_	80	0.0	\$6		\$3.18		\$117	\$130	\$15	\$115	1.39
S 197	13	1,046	9.0	\$78	\$61	\$41.37		\$1,521	\$1,696	\$195	\$1,501	1.39
P 205	က	459	0.1	\$32		\$16.97		\$351	\$391	\$45	\$346	2.10
P 207	က	413	0.1	\$31		\$16.34		\$351	\$391	\$45	\$346	2.04
P 208	က	413	0.1	\$31	\$14	\$16.34		\$351	\$391	\$45	\$346	2.04
P 209	99 99	1,831	1.7	\$137	\$182	\$72.40		\$4,563	\$5,087	\$585	\$4,502	1.01
P 229	က	413	0.1	\$31	\$14	\$16.34		\$351	\$391	\$45	\$346	2.04
P 230	က	413	0.1	\$31	\$14	\$16.34		\$351	\$391	\$45	\$346	2.04
P 252	-	89	0.0	\$7	\$2	\$3.54		\$117	\$130	\$15	\$115	1.49
P 259	-	89	0.0	\$7	\$2	\$3.54		\$117	\$130	\$15	\$115	1.49
S 291	8	161	0.1	\$12	6\$	\$6.36		\$234	\$261	\$30	\$231	1.39
P 295	27	5,409	1.2	\$403	\$126	\$213.86		\$3,159	\$3,522	\$405	\$3,117	2.75
Totals	181	22,623	7.8	\$1,686	\$845	\$894	\$39,564	\$21,175	\$23,610	\$2,715	\$20,895	1.89

	SIR		1.88
	Investment	₩	\$231
	Rebate	\$	\$30
	Total Cost	€9	\$261
	onstruction	↔	\$234
	O&M LCC Savings Construction	₩	\$433
	O&M	\$∕₹	\$11 \$11.23
		Demand \$/Yr	\$11
		Use \$/Yr	\$16
B: 75W to 18W/7T4 Savings	ings	Fxtrs kWH/Yr kW Demand	0.1
V to 18W/7	<b>Energy Savings</b>	kWH/Yr	208
B: 75M	Ш	Fxtrs	2
Fac	Š		P 256

ECO D-4 REPLACE INCANDESCENT LIGHTING WITH FLUORESCENT

Fac	C: 10	C: 100W to 18W/7T4 Savings	T4 Savings									
o Z		<b>Energy Savings</b>	sbt			O&M	LCC Savings	O&M LCC Savings Construction	Total Cost	Rebate	Investment	SIR
	Fxtrs	kWH/Yr k	kWH/Yr kW Demand	Use \$/Yr	Demand \$/Yr	\$∕7	₩	\$	\$	છ	₩	
P 80	3	86	0.2	25	\$24	\$4.41	\$421	\$351	\$391	\$45	\$346	1.21
T 120	-	349	0.1	\$26	<del>\$</del>	\$15.69	\$574	\$117	\$130	\$15	\$115	4.98
T 121	-	218	0.1	\$16	8	\$9.80	\$395	\$117	\$130	\$15	\$115	3.42
T 127	13	3,123	1.0	\$233	\$106	\$140.19	\$5,522	\$1,521	\$1,696	\$195	\$1,501	3.68
S 283	ဖ	936	0.5	\$70	\$49	\$42.02	\$1,855	\$702	\$783	\$30	\$693	2.68
Totals	24	4,725	1.8	\$352	\$195	\$212	\$8,767	\$2,808	\$3,131	\$360	\$2,771	3.16
Fac	D: 15	D: 150W to 26W/8T4 Savings	T4 Savings									
o O	Fxtrs	Energy Savings kWH/Yr kW	nergy Savings kWH/Yr kW Demand	Use \$/Yr	Use \$/Yr Demand \$/Yr		LCC Savings	O&M LCC Savings Construction \$ \$ \pms\chiral{X}\rm \mathbb{S}\$	Total Cost	Rebate \$	Investment \$	SIR
C 238	2	7 286	3.5	\$543	¢380	Ş	\$13.043	\$5,029	\$5 607	\$465	\$5 142	2 58
	j	-	}	-								i
Fac	E: 25	250W to 2-F32/T8 Savings	T8 Savings									
No.		<b>Energy Savings</b>	sbu			0&M	LCC Savings	O&M LCC Savings Construction	Total Cost	Rebate	Investment	SIR
	Fxtrs	KWH/Yr	kW Demand	Use \$/Yr	Demand \$/Yr		₩.	₩	\$	€	₩	
P 252	6	3,538	1.7	\$264	\$185	\$93.72	\$6,289	\$1,755	\$1,957	\$225	\$1,732	3.83
P 256	-	393	0.2	\$29	\$21	\$10.41	669\$	\$195	\$217	\$25	\$192	3.63
P 259	9	3,931	1.9	\$293	\$205	\$104.14	\$6,988	\$1,950	\$2,174	\$250	\$1,924	3.63
Totals	50	7,862	4	\$586	\$411	\$208	\$13,976	006'8\$	\$4,348	\$200	\$3,848	3.63
Fac	F: 30	F: 300W to 2-F32/T8 Savings	T8 Savings									
No.		<b>Energy Savings</b>	sbu				LCC Savings	O&M LCC Savings Construction	Total Cost	Rebate	Investment	SIR
	Fxtrs	KWH/Yr h	kW Demand	Use \$/Yr	Use \$/Yr Demand \$/Yr	\$/Yr	₩.	₩	₩	₩	€	
P 81	50	783	4.8	\$58	\$519	\$23.83	\$7,021	\$3,900	\$4,348	\$200	\$3,848	1.82
T 120	က	3,341	0.7	\$249	\$78	\$101.66	\$4,955		\$652	\$75	\$577	8.58
Totals	R	4,124	5.5	\$307	\$597	\$125	\$11,976	\$4,485	\$5,000	\$575	\$4,425	2.71

#### Life Cycle Cost Analysis Summary Energy Conservation Investment Program (ECIP)

ECO D8

Location: Project Title:	Fort Hunter Ligg ECIP Facility Ene	rgy Improvements		Region No. 4			Project No. Fiscal Year FY95
Discrete Porti		8 Improve Power Fa		Economic Life:	20	YEARS	Preparer: KELLER & GANNON
1. Investment	Costs			• .	_		·
A. Construction	on Costs		_	\$55,515	_		
B. SIOH			_	\$3,053	_		
C. Design Co			_	\$3,331	-		
D. Total Cost	(1A+1B+1C)		_	\$61,899			
E. Salvage Va	alue of Existing Ed	quipment				\$0	_
F. Public Utilit	ty Company Reba	ite				\$0	_
G. Total Inves	stment (1D-1E-1F)						\$61,899
2 Energy Say	vings (+)/Cost(-):						
Date of NISTI	R 85-3273-X Used	for Discount Factor	s: Oc	tober 1992	-		
Energy	Cost	Saving		Annual \$		Discount	Discounted
Source	\$/MTBU/(1)	MBTU/YR(2)		Savings(3)		Factor(4)	Savings(5)
A. Elec.	\$21.84	47		\$1,018		14.53	\$14,788
B. Dist	\$4.98		•	\$0		17.63	\$0
C. Propane	\$7.87		-	\$0		18.59	\$0
D. Demand	\$108.60	2.28	kW	\$247		14.53	\$3,593
E. Other	Ψ100.00		= ```	<b>42</b>			, , , , , , , , , , , , , , , , , , , ,
F. Total			=	\$1,265	<del></del>		\$18,381
3. Non Energ	y Savings (+) or (	Cost (-):	-	• .	_		
A. Annual Re	curring (+/-)			\$6,480			
	Factor (Table A)		-	7-7.	-	13.59	
	d Savings/Cost (3	3A x 3A1)					\$88,063
B. Non Recur	ring Savings (+)	or Cost (-)					
Item	Savings(+)	Year of		Discount		Discounted Sav-	
	Cost(-)(1)	Occur. (2)		Factor(3)		ings(+)Cost(-)(4)	
a.							
b.			-	•			•
c.			-				•
d. Total			= =		=		•
C Total Non B	Energy Discounte	d Savings (3A2+3Bo	14)			\$88,063	
4. Simple Pay	/back 1G/(2F3+3	A+(3Bd1/Economic	Life))	:		8.0	Years
	iscounted Saving					\$106,444	
	Investment Ratio					1.72	
	nternal Rate of Re					6.86%	

#### ECO D-8, Part A

#### Life Cycle Cost Analysis Summary Energy Conservation Investment Program (ECIP)

Location:	Fort Hunter Ligg	ett, California rgy Improvements	Re	gion No. 4			Project No. Fiscal Year FY95
Project little: I	ECIP Facility Ener	gy improvements 8, Part A - Power Fac	etor Cor	rection @ PG	&F M	etering Point	riscai real 1195
		o, raft A - rowel rat		onomic Life:		YEARS	Preparer: KELLER & GANNON
Analysis Date:	. June 1993			orionnio Lite.		12/11/0	. roparor. Nazzarra aranton
1. Investment	Coete						
A. Construction				\$45,781	-		
B. SIOH	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			\$2,518	-		
C. Design Cos	st			\$2,747	_		
D. Total Cost			-	\$51,046	=		
	lue of Existing Ed	quipment				<b>\$0</b>	
	y Company Reba					\$0	_
	tment (1D-1E-1F)						- \$51,046
2. Energy Sav	vings (+)/Cost(-):			h 1000	_		
Date of NISTI	R 85-3273-X Used	I for Discount Factor	s: Octo	ber 1992			
F	Coot	Soving	۸۰	nual \$		Discount	Discounted
Energy	Cost \$/MTBU/(1)	Saving MBTU/YR(2)		ıvings(3)		Factor(4)	Savings(5)
Source	\$/WIIBO/(I)	MB10/TR(2)	06	tenigs(o)		1 40101(1)	54g5(5)
A. Elec.	\$21.84			\$0.00		14.53	\$0
B. Dist	\$4.98		-	\$0.00		17.63	<b>\$</b> 0
C. Propane	\$7.87		-	\$0.00		18.59	\$0
D. Demand	\$108.60		kW	\$0.00		14.53	<b>\$</b> 0
E. Other			· ·	• •			
F. Total			*****	\$0.00	_		\$0
3. Non Energy	y Savings (+) or (	Cost (-):			_		
A Ammuni Day	numina (II)			\$6,480			
A. Annual Red	Factor (Table A)			\$0,400	_	13.59	
	d Savings/Cost (3	RΔ x 3Δ1)				10.00	\$88,063
(2) Discounte	a bavii igs/cost (c	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,					*,
B. Non Recur	ring Savings (+)	or Cost (-)					
		• • • • • • • • • • • • • • • • • • • •					
Item	Savings(+)	Year of	Di	scount		Discounted Sav-	
	Cost(-)(1)	Occur. (2)	Fa	ctor(3)		ings(+)Cost(-)(4)	
a.							
b.			-	-			
C.					_		
d. Total							
C Total Non E	Energy Discounte	d Savings (3A2+3Bo	14)			\$88,063	
4.0: 1.5		A 1 (0Dd4 /C	1 ifa\\.			7.9	Yea <b>rs</b>
		A+(3Bd1/Economic	Lile)):	•		\$88,063	1 5 41 5
	iscounted Saving Investment Ratio					1.73	
_	investment Hallo sternal Rate of Re					6.87%	

#### Life Cycle Cost Analysis Summary Energy Conservation Investment Program (ECIP)

ECO D8, Part B

Location: Project Title: I	Fort Hunter Ligge ECIP Facility Energ	y Improvements	Region No. 4		Project No. Fiscal Year FY95
		Part B - Power Factor			Drangery VELLED & CANNON
Analysis Date	: June 1993		Economic Life:	20 YEARS	Preparer: KELLER & GANNON
1. Investment	Costs				
A. Construction	on Costs		\$9,733		
B. SIOH			\$535		
C. Design Co			\$584		
D. Total Cost			\$10,853	40	
	due of Existing Equ			\$0	_
	y Company Rebate	)		\$0	#10.0F0
G. Total Inves	tment (1D-1E-1F)				\$10,853
2. Energy Sav	rings (+)/Cost(-):		0.4-14000		
Date of NISTII	R 85-3273-X Used t	or Discount Factors:	October 1992		
Energy	Cost	Saving	Annual \$	Discount	Discounted
Source	\$/MTBU/(1)	MBTU/YR(2)	Savings(3)	Factor(4)	Savings(5)
	.,,,,				
A. Elec.	\$21.84	46.6	\$1,018	14.53	\$14,788
B. Dist	\$4.98		\$0	17.63	<b>\$0</b>
C. Propane	\$7.87		<b>\$</b> 0	18.59	<b>\$</b> 0
D. Demand	\$108.60	2.28 ky	V \$247	14.53	\$3,593
E. Other				<del></del>	
F. Total			\$1,265		\$18,381
3 Non Energy	y Savings (+) or Co	ost (-):			
<u> </u>	, cago (1) 01 01	()-			
A. Annual Red			<u>\$0</u>		
	actor (Table A)			13.59	
(2) Discounted	d Savings/Cost (3A	x 3A1)			\$0
B Non Recur	ring Savings (+) or	Cost (-)			
	99- (,	()			
ltem	Savings(+)	Year of	Discount	Discounted Sav-	
	Cost(-)(1)	Occur. (2)	Factor(3)	ings(+)Cost(-)(4)	
a.					
b.			-		•
c.					•
d. Total					•
C Total Non E	Energy Discounted	Savings (3A2+3Bd4)		\$0	
4. Simple Pav	back 1G/(2F3+3A-	+(3Bd1/Economic Life	e)):	8.6	Years
	iscounted Savings		• •	\$18,381	
	Investment Ratio (S			1.69	
	iternal Rate of Retu			6.78%	

Application of Power Factor Correction Capacitors is considered for two general conditions:

- 1. Installation at the main utility metering point, and
- 2. Intstallation at each individual offending motor.

Location at the main service point will reduce billing penalties only and not improve load capabilities of the distribution system. Installation at individual motors will free up system capacity be reducing the amount of magnetizing current drawn from the utility supply.

#### 1. Installation at PG&E Metering Point - Savings Calculations

#### Data & Assumptions:

- A. PG&E rate schedule A-20 includes a 0.06% adjustment on the total billing for each 1% power factor differene from 85%. The adjustment is applied as a credit for power factors above 85% and as an additional charge for power factors below 85%.
- B. Average Main Post Billings: \$600,000 during summer period: \$400,000 during winter period.

C. Average Power Factor:

Summer period - 82/83%

Winter period - 85/86%

D. Summer Peak Demand:

3,160 kW

#### Calculations:

A. Peak kVAR (Existing)

= kW x Tan (arcCos 0.825)

= 3,160 kW x tan(34.41 degrees)

= 2,165 kVAR

B. Peak kVAR (Corrected to 95%)

= 3,160 kW x Tan (arcCos 0.95)

= 3,160 kW x Tan(18.19 degrees)

= 1,039 kVAR

C. Peak Correction Required

= 2,165 - 1,039 kVAR = 1,126 kVAR

D. Annual Savings\*

 $= $600,000 \times 12\% \times (0.06\%)/(1\%PF)$ 

= \$4,320

+ \$400,000 x 9% x (0.06%)/(1%PF)

PF)

Total Savings

= \$2,160 = \$6,480/year

<sup>\*</sup> Assuming Correction to an average Power Factor of 95%

#### 2. Installation of Power Factor Correction Capacitors @ Motor Loads

Annual kWh savings due to a reduction in motor circuit  $(1^2)R$  losses are estimated as follows (see notes):

HP	Max	Current	FLA@	Resistance	Loss	New	Savings
Rating	kVAR	Reduction	460V	Ohms/1000'	i <sup>2</sup> R (W)	Loss	
		(%)				12R (W)	(Watts)
5	2.5	22	7.6	1.620	17	10	21
7.5	3	20	11	1.620	35	23	36
10	4	18	14	1.620	57	38	57
15	5	18	21	1.018	81	54	78
20	6	17	27	0.640	84	58	78
25	7.5	17	34	0.640	133	92	123
30	8	16	40	0.410	118	83	102
40	15	16	52	0.410	200	141	177
50	17.5	15	65	0.259	197	142	165
60	20	15	77	0.164	175	126	147
75	25	14	96	0.129	214	158	168

HP	Max	Current	FLA@	Resistance	Loss	New	Savings
Rating	kVAR	Reduction	460V	Ohms/1000'	1 <sup>2</sup> R (W)	Loss	
		(%)				12R (W)	(Watts)
2	1	24	7.8	1.620	18	10	24
3	1.5	23	11	1.620	35	21	42
5	2.5	22	17.5	1.620	89	54	105
7.5	3	20	25	1.018	115	73	126
10	4	18	32	0.640	118	79	117
15	5	18	53	0.410	207	140	201
20	6	17	68	0.259	216	149	201
25	7.5	17	85	0.259	337	232	315
30	8	16	100	0.162	292	206	258
40	15	16	130	0.129	392	277	345
50	17.5	15	163	0.081	387	280	321
60	20	15	193	0.064	429	310	357
75	25	14	240	0.043	446	330	348

#### Assumptions:

- 1. kVAR values based on raising full load power factor to approx. 95%.
- 2. Motors assumed to be NEMA Design B, T-Frame, 1800 RPM.
- 3. Resistance of motor circuit assumes conductor sized at 125% of full load amps and a length of 180'.
- 4. Motor circuit savings in Watts = [Exist (I^2)R New (I^2)R] x 3

#### SCREENING ANALYSIS - 460V MOTORS

HP	Max	Savings	Labor	Material	Total Invest.[1]	Breakeven [2]
Rating	kVAR	kW	Cost	Cost	w/ SIOH & Design	Oper. Hrs/Yr
5	2.5	0.021	\$95	\$270	\$588	24,490
7.5	3	0.036	\$95	\$280	\$604	14,130
10	4	0.057	\$95	\$300	\$636	8,940
15	5	0.078	\$120	\$320	\$708	7,020
- 20	6	0.078	\$120	\$340	\$740	7,400
25	7.5	0.123	\$120	\$355	\$765	4,380
30	8	0.102	\$120	\$370	\$789	5,780
40	15	0.177	\$120	\$485	\$974	3,720
50	17.5	0.165	\$145	\$515	\$1,062	4,580
60	20	0.147	\$145	\$540	\$1,103	5,465
75	25	0.168	\$145	\$605	\$1,208	5,280

- [1] Investment = (Labor + Material) x 1.08 x 1.30 x 1.01 x 1.10 x 1.115
- [2] Breakeven Operating hours/year =

Total investment - (kW savings x \$108.60/kW x 13.59) (kW Savings x \$0.07454 x 14.53)

#### SCREENING ANALYSIS - 200V MOTORS

HP	Max	Savings	Labor	Material	Total Invest.[1]	Breakeven [2]
Rating	kVAR	kW	Cost	Cost	w/ SIOH & Design	Oper. Hrs/Yr
2	1	0.024	\$85	\$240	\$523	18,760
3	1.5	0.042	\$85	\$275	\$580	11,390
5	2.5	0.105	\$115	\$345	\$740	5,145
7.5	3	0.126	\$115	\$360	\$765	4,245
10	4	0.117	\$130	\$380	\$820	4,675
15	5	0.201	\$130	\$400	\$853	2,555
20	6	0.201	\$130	\$420	\$885	2,700
25	7.5	0.315	\$150	\$465	\$990	1,540
30	8	0.258	\$150	\$500	\$1,046	2,380
40	15	0.345	\$180	\$765	\$1,521	2,710
50	17.5	0.321	\$200	\$860	\$1,706	3,545
60	20	0.357	\$215	\$920	\$1,827	3,520
75	25	0.348	\$235	\$1,100	\$2,149	4,340

- [1] Investment = (Labor + Material) x 1.08 x 1.30 x 1.01 x 1.10 x 1.115
- [2] Breakeven Operating hours/year =

Total investment - (kW savings x \$108.60/kW x 13.59) (kW Savings x \$0.07454 x 14.53)

Life cycle cost analyses for motor installations meeting the minimum breakeven hours/yr are developed in the following spreadsheet.

CAPACITORS INSTALLED AT MOTOR LOAD

Bldg.	Supply		Return		Total	Usage	kWh
No.	HP	kW Saving	HP	kW savings	kW Savings	Hrs/Yr	Savings
205	25	0.315	10	0.117	0.432	5,840	2,523
207	25	0.315	10	0.117	0.432	5,840	2,523
208	25	0.315	10	0.117	0.432	5,840	2,523
210	10	0.117	-	-	0.117	8,760	1,025
229	25	0.315	10	0.117	0.432	5,840	2,523
230	25	0.315	10	0.117	0.432	5,840	2,523
				-	2.277		13,639

Note: All motors are 200V

Annual Demand Savings = 2.277 kW x \$108.60/kW

= \$247

Annual Mil BTU Savings = 13,640 kWh x 0.003413 Mil BTU/kWh

= 46.6 Mil BTU

CONSTRUCTION COST ESTIMATE  Project  EEAP Limited Energy Study				Date Prepare June 19						
				Project No.	Basis for Estimate					
Location Location			141111	<u> </u>	Code A	(no design com	peted)			
Fort Hunter-Liggett, California Engineer-Architect				<del></del>						
Keller & Gannon										
Drawing No.		Estimato	or		Checked	Ву				
ECO-D8 PF Corr-PG&E Metering Po		RCL			BIH					
Line Item	No.	uantity Unit	Per	Labor	Per	Material	Total			
2	Units	Meas.	Unit	Total	Unit	Total	Cost			
1200 kVAR, 12 kV pad mounted										
capacitor bank including					<u></u>					
incoming line section and										
capacitor switching	-	LS	-	\$4,000	<u> </u>	\$23,000	\$27,000			
Concrete pad & site work	-	LS	-	\$800	-	\$200	\$1,000			
Feeder to PG&E metering location	30	LF	\$25	\$750	\$20	\$600	\$1,350			
				ļ						
Quotation from LGE Electrical	ļ									
Sales, Inc. for ABB Brown Boveri										
equipment dated 2/18/93	ļ			<u> </u>						
Subtotal	<del> </del>						\$00.3E0			
General Conditions @ 8%	+						\$29,350 \$2,348			
Subtotal	+						\$31,698			
Contractor OH & Profit @ 30%	<del> </del>				-		\$9,509			
Subtotal							\$41,207			
Bond @ 1%	<del> </del>			<del>                                     </del>			\$412			
Subtotal	+			-			\$41,619			
	+		-				\$4,162			
Estimating Contingency @ 10%  Total Probable Construction Cost	+-				-		\$45,781			
Total Flobable Construction Cost	<del> </del>				<del> </del>		φ <del>4</del> 5,761			
	+	<b></b>			<del> </del>					
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				Date Prepare		Sheet	OF	
CONSTRUCTION COST E	June 19	1						
Project			Project No.	Basis for Estimate				
EEAP Limited Energy Study								
Location					Code A	(no design con	npeted)	
Fort Hunter-Liggett, California								
Engineer-Architect								
Keller & Gannon Drawing No.		Estimate	or .		Checked	Bv		
ECO-D8 PF Corr. @ individual mot	RCL			він	-,			
ECC-DO 11 Con. @ marriada mot	0.0	uantity		Labor		/laterial		
Line Item	No. Units	Unit Meas.	Per Unit	Total	Per Unit	Total	Total Cost	
A LV/AD Consoiter	5	EA	\$130	\$650	\$380	\$1,900	\$2,550	
4 kVAR Capacitor	6	EA	\$150	\$900	\$465	\$2,790	\$3,690	
7.5 kVAR Capacitor	0	EA	\$150	\$900	<b>Ψ403</b>	\$2,790	φ3,090	
			<u>.</u>					
	<b>}</b>							
Subtotal				\$1,550		\$4,690	\$6,240	
General Conditions @ 8%							\$499	
Subtotal							\$6,739	
Contractor OH & Profit @ 30%							\$2,022	
Subtotal							\$8,761	
Bond @ 1%							\$88	
Subtotal							\$8,849	
Estimating Contingency @ 10%							\$885	
Total Probable Construction Cost							\$9,733	
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installation: Fort Hunter Liggett,	California
project: ECIP Facility Energy I	mprovements
project number temporary:	program year 1995
permanent:	category code 80000
point of contact:	date
title	phone
	autovon
dfae name	date
title	phone
	autovon
engineer district name	date
title	phone
	date phone
	autovon
reviewed by: installation facility engineer name title	date phone
	date
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	agioron

project development brochure, PDB-1

DA FORM 5020-R, Feb 82

### facility

ECIP Facility Energy Improvements
Fort Hunter Liggett, Calif.

## project coordinator for using service

functional requirements summary, PDB-1

1 of 9

DA FORM 5020-1-R, Feb 82

#### PROJECT OBJECTIVE

The objective of this project is to reduce energy consumption in cantonment area buildings by implementation of the following retrofits:

- a. Install batt insulation in the ceilings of 9 buildings.
- b. Install programmable controllers in 9 buildings.
- c. Insulate hot water heating and cooling water piping in 12 buildings.
- d. Install 24-hour programmable thermostats in 28 buildings.
- e. Replace space cooling equipment in 10 buildings with more efficient systems.
- f. Install automatic-draft damper controls on space heating equipment in 20 buildings.
- g. Convert dual-duct air-handling system to variable air volume in 5 barracks buildings.
- h. Replace boilers with high-efficiency units in 7 buildings.
- i. Insulate domestic hot water piping in 6 buildings.
- j. Insulate 16 domestic hot-water storage tanks in 13 buildings.
- k. Install self-metering lavatory faucets in 3 buildings; and install lavatory and shower flow restrictors in 2 buildings.
- 1. Install dishwasher heat recovery unit in Building 206.
- m. Install automatic-draft dampers on domestic hot water heaters in 3 buildings.
- n. Replace incandescent lighting fixtures with fluorescent fixtures in 9 buildings.
- o. Install automatic power factor correction equipment at utility metering point. Install power factor correction capacitors on 10 HP and larger motors in 6 buildings.

#### SPACE AND REQUIREMENTS

No additional space is required to implement this energy conservation project.

\1640310\INSERT.CUT 930721-2

#### functional requirements summary, PDB-1

DA FORM 5020-2-R, Feb 82

2 of

# SUMMARY OF FUTURE CHANGES AND IMPACTS The buildings affected will consume less energy than they would have if this project had not be implemented. \1640310\INSERT.CUT functional requirements summary, PDB-1

DA FORM 5020-2-R, Feb 82

#### A. SPECIAL CONSIDERATIONS

A-1 Cost estimates for each primary and supporting facility  A-2 Telecommunications system coordination with USACC and authorization for exceptions  A-3 Coordination with state and local governmental requirements (blind vendors, medical facilities, construction and operating permits, clearinghouse ecoordination, etc.)  A-4 Assignment of airspace  Economic analysis of alternatives  A-5 Economic analysis of alternatives  A-6 Approval for new starts  International balance of payments (IBOP) coordination with U.S. European command and NATO—overseas cost estimates and comparables (include rate of exchange used in estimates)  A-8 Impact on historic places—on site survey by authorized archeologist and coordination with state historic preservation officer and advisory council on historic preservation  A-9 Exceptions to established criteria  A-10 Coordination with various staff approies (Provest Marshall physical sequences)	R NR	R I NR NR NR I NR NR		Comment	Document
Coordination with state and local governmental requirements (blind vendors, medical facilities, construction and operating permits, clearinghouse ecoordination, etc.)  A-4 Assignment of airspace  Economic analysis of alternatives  A-5 Economic analysis of alternatives  A-6 Approval for new starts  A-7 International balance of payments (IBOP) coordination with U.S. European command and NATO—overseas cost estimates and comparables (include rate of exchange used in estimates)  A-8 Impact on historic places—on site survey by authorized archeologist and coordination with state historic preservation officer and advisory council on historic preservation  A-9 Exceptions to established criteria  A-10 Coordination with various staff agencies (Provost Marshall-physical security, etc.)  A-11 Identification of related or support projects (so projects can be coordinated)  A-12 Required completion date	NR NR R NR NR NR NR NR NR R	NR NR R I NR NR NR NR NR NR NR NR NR			
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A-11 Identification of related or support projects (so projects can be coordinated) A-12 Required completion date	R	R A			
A-12 Required completion date		1			
Other Special Considerations (List and number items)	_К	-K- -	1_		
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REQUIRED OR NOT REQUIRED — Not relevant or no information to communicate. Enter "R" if item is relevant and is required for this project. Enter "NR" if item is irrelevant and is not required for this project.

TO BE DETERMINED — Information needed but not currently available. Enter code for information source.

COMMENT ATTACHED — Significant information summarized or explained and attached.

DOCUMENT ATTACHED — Significant information is in an existing document which is attached.

\*BY WHOM (Check and insert appropriate letter)

- A DEAL
- B Using Service
- C Construction Service
- D Designer
- E + Other (Check Comments Attached and explain)

## documentation checklist

4 of 9

DA FORM 5023-A-R, Feb 82

#### C. ARCHITECTURAL & STRUCTURAL

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	ITEM	Required Not Requ	To Be Determine	Comment	Documen
<u>C-1</u>	Reconciliation with troop housing programs and requirements	NR			
C-2	Evaluation of existing facilities (including degree of utilization)	NR	1		
C-3	Approval for removal and relocation of existing useable facilities	NR	<del>                                     </del>		
<u>C-4</u>	Evaluation of off-post community facilities	NR		<del></del>	
<u>C-5</u>	Storage and maintenance facilities (including nuclear weapons)	NR			
<u>C-6</u>	Coordination hospitals, medical and dental facilities with Surgeon General	NR			
C-7	Coordination of aviation facilities with FAA	NR			<del> </del>
<u>C-8</u>	Coordination air traffic control and navigational aids with USACC	NR	<del>                                     </del>		
C-9	Tabulation of types and numbers of aircraft	NR	<del> </del>		
C-10	Evaluation of laboratory, research and development, and technical maintenance facilities	NR	-}	<u> </u>	
C-11	Coordination chapels with Chief of Chaplains	NR	<del> </del>		
C-12	Review food service facilities by USATSA	NR	1	<del> </del>	<del></del>
C-13	Automated data processing system or equipment approvals—cost analysis when ADP and/or communication centers not co-located with related facilities				
C-14	Coordination postal facilities with U.S. Postal Service Regional Director	NR	-		
C-15	Laundry and dry cleaning facilities coordination with ASD(I&L)	NR.	-		<u> </u>
C-16	Tenant facilities coordination with installation where sited	NR	<del> </del>		
C-17	Facilities for or exposed to explosions, toxic chemicals, or ammunition—review by DDESB (See also Item 8-4)	NR	-		
C-18	Analysis of deficiencies	NR	-		
C-19	Consideration of alternatives	R.	<u> </u>		<u> </u>
C-20	Determination whether occupants will Include physically handicapped or disabled persons	_R_	<u> </u>		
C-21	As-build drawings for alterations or additions	NR.		<b> </b>	
C-22	Availability of Standard Design or site adaptable designs	R_	<del>  C</del>		
	Other Architectural & Structural (List and number items)	_NR	-	<b> </b>	
	<u>-</u>				

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- A DFAE
- B Using Service
- C Construction Service
- D Designer
- E Other (Check Comments Attached and explain)

## documentation checklist 5 of 9

DA FORM 5023-C-R, Feb 82

#### D. MECHANICAL, ELECTRICAL, & UTILITY SYSTEMS

	ITEM
D-1	Fuel considerations and cost comparison analysis
D-2	Energy requirements appraisal (ERA)
D-3	Conformance with DOD Energy Reduction requirements
D-4	Evaluation of existing and/or proposed utility systems
	Other Mechanical and Utility Systems (List and number items)

Redui Not R	Required or Not Required
To Be To Be Determined	Be * termined
Comm	Comment Attached
Docun Attach	Document Attached

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\*BY WHOM (Check and insert appropriate letter)

A - DFAE

8 - Using Service

C - Construction Service

D - Designer

E -Other (Check Comments Attached and explain)

## documentation checklist

DA FORM 5023-D-R, Feb 82

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#### A. SPECIAL CONSIDERATIONS

	ITEM
•	Factors of risk, restriction or unusual circumstance expected to increase costs beyond applicable area averages
_	Construction phasing requirements
<u> </u>	Functional support equipment (mechanical, electrical, structural, and security) to be built in
	Equipment in place and justification
5	Other equipment and furniture (O&MA, OPA) and costs
<u> </u>	Special studies and tests (hazards analyses, compatibility testing, new technology testing, etc.)
_	Type of construction (permanent, temporary, semi-permanent)
	Government furnished equipment (quantities, procurement time, availability and special handling and storage requirements). Funds used for procurement.

	Required or Not Required	To Be • Determined	Comment Attached	Document Attached
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\*BY WHOM (Check and insert appropriate letter)

- A DFAE
- B Using Service
- C Construction Service
- D Designer
- E Other (Check Comments Attached and

## technical data checklist

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DA FORM 5024-A-R, Feb 82

#### C. ARCHITECTURAL & STRUCTURAL

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	ITEM	Require	Not Requi	To Be Determine	Comment Attached	Document Attached
C-1	Vibration-producing equipment requiring isolation					
C-2	Seismic zone and other design load criteria (typhoon, hurricane, earthquake loads, high or low loss potential)			_D_		
C-3	Protective shelter evaluation and resistant design criteria (conventional/nuclear blast and radiation, chemical/biological)		R_			
C-4	Unusual foundation requirements (pier, pile, caisson, deep foundations, mat, special treatment, permafrost areas, soil bearing)		R_			
C-5	Designation and strength of units to be accommodated	N				
C-6	Requirements and data for special design projects	N				
C-7	Unusual floor and roof loads (safes, equipment)	N				
C-8	Security features (arms rooms, vaults, interior secure areas)	_N				
	Other Architectural & Structural (List and number items)	П	R_			
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\*BY WHOM (Check and insert appropriate letter)

or a sed

A - DFAE

B - Using Service

C - Construction Service

D - Designer

E - Other (Check Comments Attached and explain)

## technical data checklist

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DA FORM 5024-C-R, Feb 82

#### D. MECHANICAL, ELECTRICAL, & UTILITY SYSTEMS

D-1 Special mechanical requirements or considerations (elevator, crane, hoist, etc.)	]	Required Not Req	ء ۾ ا	1
D-1 Special mechanical requirements or considerations (elevator, crane, hoist, etc.)		Z A	To Be Determir	
	7	NR		Ī
D-2 Special peak usage periods and peak leveling techniques	۱ ا	NR		ŀ
D-3 Maintenance considerations (accessibility of equipment, compatibility with existing equipment	1	R	В	ł
D-4 Plumbing—availability, general system type and characteristics (proposed and/or existing, inc compressed air and gas)		NR		İ
D-5 Heating—availability, general system type and characteristics (proposed and/or existing)	┨	R	В	ŀ
D-6 Ventilating, air condition/refrigeration—availability, general system type and characteristics (proposed and/or existing)		R	В	
D-7 Electrical—availability, general system type and characteristics incl. airfield lighting, communication, etc. (proposed and/or existing)		NR	<u> </u>	ŀ
D-8 Water supply/waste treatment—availability, general system type and characteristics (propose and/or existing)	1			ŀ
D-9 Energy requirements/fuel conversion (sources, availability, loads, types of fuel, etc.)	┨	NR R		ŀ
D-10 Solar energy evaluation	┪	NR	В	ŀ
Other Mechanical & Utility Systems (List and number items)		M		

REQUIRED OR NOT REQUIRED — Not relevant or no information to communicate. Enter "R" if item is relevant and is required for this project. Enter "NR" if item is irrelevant and is not required for this project.

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\*BY WHOM (Check and insert appropriate letter)

- A DFA
- B Using Service
- C Construction Service
- D Designer
- E Other (Check Comments Attached and explain)

## technical data checklist

9 of 9

DA FORM 5024-D-R, Feb 82